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An Assessment of the Stocking of Atlantic Salmon *(Salmo salar L.)* Fry in the Tributaries of the Middle Exploits River, Newfoundland

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AN ASSESSMENT OF THE STOCKING OF ATLANTIC SALMON (*SALMO SALAR* L.) FRY IN THE TRIBUTARIES OF THE MIDDLE EXPLOITS RIVER, NEWFOUNDLAND

by

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O'Connell, M. F., J. P. Davis, and D. C. Scott. 1983. An assessment of the stocking of Atlantic salmon (*Salmo salar* L.) fry in the tributaries of the Middle Exploits River, Newfoundland. Can. Tech. Rep. Fish. Aquat. Sci. 1225: v + 142 p.

The tributaries of the middle Exploits River were stocked with swim-up anadromous Atlantic salmon fry from an artificial spawning channel and two deep substrate upwelling incubation boxes. From 1968 to 1975, fry were stocked on Noel Paul's Brook at an average density of 42/100 m^2 utilizing production from the spawning channel; the total number stocked ranged from 139,880 (1968) to 369,689 (1973). From 1976 to 1980, using the combined production from the spawning channel and the incubation boxes, stocking was expanded to include several other tributaries in addition to Noel Paul's Brook. Overall average stocking density was 75 fry/100 m^2; the total number of fry stocked ranged from 696,897 (1979) to 1,827,374 (1980). Adult escapements corresponding to the low level stocking ranged from 64 in 1974 to 340 in 1975. A total of 462 adults were enumerated in 1979; however, based on smolt age composition some of these were ascertained to be first returns to the expanded stocking in 1976. Adult returns corresponding to the first three years of high level stocking ranged from 2,388 (1982) to 4,022 (1981). There are indications that adult returns from the high level of stocking resulted in a dramatic increase in commercial catches in the Bay of Exploits; the effect on the recreational fishery was not as pronounced. The percentage of returning adults corresponding to a given year of fry stocking was higher for the expanded stocking phase. This is discussed in terms of changes in exploitation, straying rate in relation to changes in pollution levels and brood stock suitability (donor sources were different for each level of stocking). The fry stocking method of colonization is compared with that of the use of adults spawning in natural stream habitat with respect to efficient use of available brood stock.

Key words: Atlantic salmon, deep substrate incubator, artificial spawning channel, fry stocking, colonization, salmon enhancement, Newfoundland.

RÉSUMÉ

O'Connell, M. F., J. P. Davis, and D. C. Scott. 1983. An assessment of the stocking of Atlantic salmon (*Salmo salar* L.) fry in the tributaries of the Middle Exploits River, Newfoundland. Can. Tech. Rep. Fish. Aquat. Sci. 1225: v + 142 p.

Des alevins de saumon de l'Atlantique anadrome ont été relâchés dans les tributaires de la partie centrale de la rivière des Exploits à partir d'un chenal de frai et de deux boîtes d'incubation avec circulation d'eau dans un épais substrat. De 1968 à 1975, la production d'alevins à partir du chenal de frai a servi à l'ensemencement de ruisseau Noel Paul à raison de 42 alevins par 100 m^2 en moyenne. Le nombre total d'alevins relâchés a varié entre 139 880 (1968) et 369 689 (1973). De 1976 à 1980, la production combinée du chenal de frai et des boîtes d'incubation a servi à ensemencer plusieurs autres tributaires. Au total, le densité moyenne d'ensemencement équivalait à 75 alevins par 100 m^2, cependant que le nombre total d'alevins ensemencés variait de 696 897 en 1979 à 1 827 374 en 1980. Les remontées de saumons adultes

correspondant à un faible niveau d'ensemencement se chiffraient en 1974 à 64 et en 1975 à 340. Quatre cent soixante-deux saumons adultes ont été au total dénombrés en 1979. D'après la répartition des tacons selon l'âge, il a été cependant démontré que certain d'entre eux effectuaient leur première reomntée depuis l'augmentation des niveaux d'alevinage en 1976. Les remontées de saumons adultes correspondant aux trois premières années de l'augmentation des niveaux d'alevinage se sont chiffrées en 1981 à 4 022 individus et en 1982 à 2 388. Il semble que les remontées depuis l'augmentation des niveaux d'alevinage aient entraîné une hausse spectaculaire des prises commerciales dans la baie des Exploits, mais qu'elles n'aient pas eu des conséquences aussi marquées sur la pêche sportive. Le pourcentage de la remonte correspondant à une année donnée d'alevinage s'est avéré supérieur depuis l'augmentation des niveaux d'ensemencement. La présente étude traite des changements survenus au niveau de l'exploitation, du taux d'errement par rapport à la variation des niveaux de pollution et de la qualité du stock reproducteur (les sources d'approvisionnement différaient d'un niveau d'alevinage à l'autre). Le document compare aussi la méthode de colonisation par alevinage à l'emploi de la fraie de saumons adultes en milieu naturel dans le contexte de l'utilisation efficace du stock reproducteur disponible.

Mots-clés: saumon de l'Atlantique, incubateur avec couche épaisse de substrat, chenal de frai, alevinage, colonisation, mise en valeur des salmonidés, Terre-Neuve.

INTRODUCTION

The Exploits River is the largest in insular Newfoundland with a drainage area of 11,272 km^2 (Porter et al. 1974) (Fig. 1). Historically, less than 10% of the total watershed area was accessible to anadromous Atlantic salmon (*Salmo salar* Linnaeus) due to the presence of natural and industrial obstructions to upstream migration (Taylor and Bauld 1973).

The introduction of anadromous Atlantic salmon into previously uninhabited areas of the Exploits River began as a result of events that transpired on Rattling Brook, an adjacent river system flowing into the Bay of Exploits (Fig. 2). A hydro development on that river that began in 1956 would have effectively eliminated its run of Atlantic salmon. At that time, it produced the third highest angling catch in insular Newfoundland (Farwell 1975). It was therefore decided in 1956 to transfer the entire Rattling Brook adult run to Great Rattling Brook (Sturge 1966), a tributary of the lower Exploits (watershed area below Grand Falls) (Fig. 2). This was accomplished between 1957 and 1965. Each year over that period adults were captured by means of a counting fence and transported by tank truck above an impassable obstruction located at Camp I on Great Rattling Brook. The peak year of transfer was 1958 when 786 fish were stocked on Great Rattling Brook. It was subsequently determined that transferred adults were spawning successfully in their new habitat and that juveniles were being produced (Sturge 1966). A fishway was constructed at Camp I in order to accommodate predicted significant adult returns in 1962 resulting from the first fish transferred in 1957. A total of 1,068 adults were enumerated at the fishway in 1962. Since that time escapements have increased steadily reaching a maximum of 6,556 adults in 1975.

In view of the success realized by the Rattling Brook transfer, attention was next turned to developing the tributaries of the middle Exploits (Fig. 2) encompassing the watershed area between Grand Falls (an impassable obstruction) and a storage dam located at the outlet of Red Indian Lake (also an impassable obstruction). In order to make the most efficient use of available brood stock, the method of colonization adopted for the middle Exploits was stocking with swim-up fry as opposed to an adult transfer such as used on Great Rattling Brook (Farwell 1975). This decision stemmed from results obtained at Indian Brook, Newfoundland, where a three-fold increase in egg to fry survival was observed from adults spawning in an artificial spawning channel compared with those utilizing natural stream habitat (Sturge 1968; Pratt et al. 1974). In 1967, a spawning channel was constructed on Noel Paul's Brook, a large tributary of the middle Exploits; fry stocking commenced on that tributary in 1968. Smolt production resulting from fry stocking (Pratt et al. 1974) proved encouraging. Therefore, a partial fishway was completed at Grand Falls in order to capture returning adults (essentially adults are collected at this facility and transferred to a tank truck for transport around Grand Falls). Adult returns were likewise encouraging. In order to improve cost-effectiveness of the project and to justify eventual completion of the Grand Falls fishway, thereby creating a self-sustaining run, it was evident that additional production was required from the middle Exploits. In 1975, the fry production capacity at Noel Paul's Brook was greatly increased with the addition of two deep substrate upwelling incubation boxes. These boxes were patterned after those in use at the time for Pacific salmonids (see Bams and Simpson 1977) where average egg to fry survivals of around 75% were being obtained (Bams 1973; Ginetz 1976). With the combined fry production from the spawning channel and the incubation boxes, stocking was expanded in 1976 to include several other tributaries in addition to Noel Paul's Brook.

The only previous assessment of the fry stocking on the middle Exploits River is that of Pratt et al. (1974) who examined juvenile production on Noel Paul's Brook covering the period 1968-73. The present analysis deals primarily with adult returns corresponding to each of the levels of stocking referred to above.

HUMAN HABITATION, INDUSTRIALIZATION AND POLLUTION

There are seven major communities located in the Exploits River watershed; of these, only one (Badger) treats its domestic wastes prior to discharge into the river (Farwell 1975).

A pulp and paper mill has been in operation at Grand Falls since 1909. This mill discharges its effluent into the Exploits in the same general area where domestic sewage from the towns of Grand Falls and Windsor enters. Logging (pulp wood) has occurred over much of the watershed area of the Exploits over the years. The logging strategy followed has been that of clear-cutting which involves changing areas of logging activity as forests are harvested and regrow to maturity. Log driving has resulted in the erection of numerous small storage dams some of which were removed in the mid-1960s after surrounding forested areas were harvested.

In 1927, a base metal mine and concentrator (producing copper, lead and zinc) went into operation at Buchans. Prior to 1966, mine tailings were discharged directly into Buchans Brook where they were carried downstream into Red Indian Lake. Since 1966, tailings have been discharged into a settling pond and the effluent treated prior to discharge into Buchans Brook.

Hydroelectric developments have had a significant impact on the Exploits River. In 1909, the pulp and paper company commenced generation of power at two plants located on the main stem, one at Grand Falls and one at Bishop's Falls, both of which are still in operation. Associated with each power plant was the construction of a head-pond dam. The dam at Grand Falls is located just upstream from the falls. Historically, the Bishop's Falls dam was not a complete obstruction to adult salmon migration; fish were usually held up for varying periods during low flows. With the realization that such a hinderance could prove somewhat troublesome if escapements continued to increase as a result of development, a modified fishway was completed in 1971. This facility serves to ease adult passage thereby preventing a bottle neck. The storage dam at the outlet of Red Indian Lake (constructed in 1909) already mentioned and another, Goodyears dam, which was constructed in 1975 and is located approximately 3 km upstream from the Grand Falls dam, are also used to regulate flows for hydroelectric generation as well as log driving. Goodyears dam is not a barrier to fish migration in that it possesses two fishways. In 1963, a generating plant was constructed on Sandy Brook (7.3 km from the mouth), a major tributary of the middle Exploits. In 1968, a drainage area of some 1,060 km^2 was removed from the upper Exploits (drainages flowing into Red Indian Lake (Fig. 2)) when the Victoria River watershed area above the outlet of the Victoria Lake was diverted to the Bay d'Espoir power development.

More detailed information on human activity and pollution in the Exploits River watershed can be found in Taylor and Bauld (1973), Wilson (1974), Farwell (1975) and Morry and Cole (1977).

FISH SPECIES PRESENT

Fish species present in the Exploits River in addition to indigenous and introduced anadromous Atlantic salmon include ouananiche (landlocked Atlantic salmon), Eastern brook trout (Salvelinus fontinalis (Mitchill)), Arctic char (Salvelinus alpinus (Linnaeus)), American eel (Anguilla rostrata (LeSueur)) and threespine stickleback (Gasterosteus aculeatus Linnaeus).

MATERIALS AND METHODS

The Noel Paul's Brook controlled flow spawning channel has been described previously (Pratt 1968; Taylor and Bauld 1973). Essentially the channel consisted of 5 spawning riffles interspersed with 3 brood holding pools (beginning upstream - between riffles 1 and 2, 2 and 3, and 4 and 5). A drop structure was located at the downstream end of each of riffles 3 and 5. The two upwelling incubation boxes were installed on riffle 1 immediately above the first holding pool. These have been described in detail by Porter and Meerberg (1977). The loss of riffle 1 resulted in a reduction of approximately 12% in the total available spawning area of the channel. In the first year of operation (1975) crushed gravel (1.9-3.8 cm) was used as the incubation substrate in one box while Astroturf (Marine Surface FH.01 by Monsanto) was used in the other. The following year, Astroturf was used in both boxes. Fig. 3 is a schematic representation of the channel after installation of the incubation boxes while aerial photographs of same are shown in Fig. 4.

Brood sources and the number of fish utilized from each source are shown in Table 1. From 1967 to 1973, the channel was stocked using brood from Adies Stream, a tributary of the Humber River (Fig. 1). In 1974, in addition to those from Adies Stream, a small number of fish from the Grand Falls collection facility was used. Beginning in 1975, the channel and the incubation boxes were stocked using brood taken from Camp I fishway on Great Rattling Brook and the Grand Falls collection facility. Brood were transported from the collection sites to the channel (during July and August) by tank truck. In September, they were sexed, weighed and allocated to each pool in numbers sufficient to achieve the desired female density on each riffle. For Great Rattling Brook/Grand Falls brood fish, in order to ensure that enough males were avilable for both the channel and incubation boxes, a number of fish in excess of spawning requirements (taken from Great Rattling Brook) were held at the channel each year; during allocation, the sex ratio (female:male) was adjusted to approximately 3.0:1 and excess fish taken back downstream to Great Rattling Brook and released.

From 1975 to 1979, the allocation to pool no. 1 was used to stock the incubation boxes. The number of females allocated to the incubation boxes and each channel spawning section, female density and the mean weight of females are presented in Table 2. A small number of large salmon (<10) were transported to the channel in some years; however, no attempt was made to segregate these from grilse. Natural spawning in the channel usually commenced around mid-October. Stripping of brood fish for the incubation boxes generally occurred over the period from the last week in October through the first week in November. Egg deposition in the channel was estimated by multiplying the total weight of females by a fecundity of 1,650 eggs/kg for Adies Stream stock (Pratt et al. 1974) and 1,622 eggs/kg for Great Rattling Brook/Grand Falls fish. The number of eggs planted in the incubation boxes was estimated by volumetric displacement. The details of this technique plus all operational procedures pertaining to collection, holding and allocation of brood and stocking of eggs in both the channel and the incubation boxes can be found in Davis et al. (1978).

Fry emerging from the channel were collected by means of 3 Wolf traps installed immediately below each drop structure (Fig. 5). Fry from riffles 2 and 3 were collected at the first drop structure and those from riffles 4 and 5 at the second. Fry emerging from riffle 1 (which prior to incubation box installation was generally used for experimental purposes) were collected in a temporary weir. Wolf traps were also used to collect the fry from each chamber of both incubation boxes (Fig. 6). Enumerations were made by direct count when levels of emergence were low and by volumetric displacement when large numbers (Fig. 7) were encountered. Fry were distributed by helicopter. Prior to 1979, between 15,000 and 25,000 fry were carried per trip (utilizing 5 gal. (18.9 litre) plastic buckets each containing up to 2,000-2,500 fry in 14 litres of water). Over long distances, temperature was controlled and oxygen replenished by replacing the water in the buckets. In 1979 and 1980, fry were carried in 46 x 76 cm plastic bags containing one-third water and two-thirds pure oxygen. For transport inside the helicopter, the bags were placed in large plastic garbage containers. Temperature was controlled by packing ice between the bags. The total number of fry carried per trip using this method ranged from 30,000 for trips lasting up to 30 minutes to the time of release to 50,000 for trips of 10 minutes duration or less. The number of fry per bag ranged from 2,500 to 5,000 depending on the distance.

Stocking was limited mainly to stream areas displaying characteristics similar to the parr rearing habitat described by Elson (1957a) and Riche (1972). Based on observations with respect to the dispersal of unfed fry stocked on Indian Brook, Newfoundland by Sturge (1968), fry on the Exploits River were released at predetermined sites spaced at 0.40 km intervals. They were evenly dispersed over the entire width of the river carefully avoiding large concentrations.

The tributaries and years each was stocked are shown in Fig. 8. The total number of fry stocked on each tributary, the numbers of 100 m^2 units of habitat stocked and stocking density are presented in Table 3. From 1968 to 1975, stocking was conducted on Noel Paul's Brook only utilizing fry from the spawning channel; stocking density ranged from 25 (1974) to 64 (1970) fry/100 m^2 with a mean of 42/100 m^2. Beginning in 1976, with the increased fry production resulting from the installation of the two incubation boxes, additional tributaries were stocked. Mean stocking density for the period 1976-80 on Noel Pauls Brook increased to 71 fry/100 m^2; the range was 62 (1980)-80 (1977) fry/100 m^2. Mean stocking density for Badger Brook, Little Red Indian Brook and Tom Joe's Brook over the same period was 102, 60, and 129 fry/100 m^2 respectively; the range was 95 (1976)-108 (1977), 50 (1979)-65 (1980) and 53 (1976)-259 (1978) respectively. From 1976 to 1978, Mary March Brook in the upper Exploits was stocked for experimental purposes; mean density for the three years was 62 fry/100 m^2 with a range of 45 (1976) to 95 (1978)/100 m^2. An excess number of fry compared to other years were produced in 1980; these were stocked into Harpoon Brook (101/100 m^2), Junction Brook (158/100 m^2) and Aspen Brook (124/100 m^2). The mean stocking density for all tributaries combined between 1976 and 1978 was 75 fry/100 m^2. Distribution sites on each tributary and the number of fry released at each site for each consecutive year of stocking can be found in Pratt et al. (1974), Mercer and Anderson (1974), Davis and Farwell (1975), Davis (1977), Davis and Caines (1977), Davis et al. (1978) and Davis and Scott (1983). Operational procedures for all aspects of the fry run are presented in Davis et al. (1978). With a few exceptions, all tributaries stocked were relatively undisturbed by industrial activity over the entire stocking period. The exceptions occurred in 1980 when stocking on the Mary Ann Brook tributary of Badger Brook and on Harpoon Brook was limited due to log driving.

Smolts and kelts were enumerated at the forebay of the hydroelectric generating plant at Bishop's Falls by means of a reverse fishway. The forebay collected only a portion of the smolts and kelts leaving the Exploits River; the geat majority passed over the dam unhindered. Entrapment of fish in the forebay occurred when all 9 turbines were operational. The mechanism for entrapment appeared to be disorientation in response to the churning, non-directional movement of the water mass created by turbine operation. This prevented the location of the exit from the forebay (small numbers did leave however, in spite of this). Fig. 9 shows the exit observed from both inside (all turbines operational) and outside of the forebay; the smolt enumeration facility is also shown. Smolts left the forebay when all but the two turbines closest to the exit were shut down. What in effect happened when this procedure was followed was the stilled water conditions over the major part of the forebay allowed orientation while the two turbines near the exit provided an attraction flow. Smolts and kelts were collected in the reverse fishway as they emerged from the exit. The timing of turbine shut-down was synchronized with the pulp and paper mill operations which at times accounted for several days of smolt accumulations prior to release. Normally each year, summer drawdown resulted in insufficient head pressure behind the Bishop's Falls dam for efficient operation of the turbines. Also at this time, the water level in the forebay barely reached the exit. This situation resulted in several days of accumulations of fish with very little release. The problem was rectified by placing flashboards along the entire dam (Fig. 10) which increased the height of the head-pond by approximately 1.2 m. While the water level was building up to the point where it flowed over the flashboards (approximately 24 hours), all smolts and kelts leaving the head-pond were channelled through the forebay. On occasion all turbines were shut down for varying periods of time during the smolt run for maintenance and other reasons. As a consequence, the stilled water conditions resulted in relatively few fish being captured in the forebay.

From 1972 to 1979, for a few days during the peak of the run each year, the numbers of smolts entering the reverse fishway trap were visually estimated en masse as opposed to being individually counted. This was necessary because the design of the trap was such that holding for the time period required to do individual counts when large numbers were encounterd often resulted in mortalities. On occasion, these estimates were checked against actual counts and were found to be underestimates by about 20%. For the period 1980-82, design changes in holding facilities allowed direct enumerations to be carried out.

Adult enumerations were made by means of a trap installed in each of the fishways. The Bishop's Falls fishway provided a count of all fish entering the river minus the number taken in the recreational fishery occurring downstream from that facility. Upstream from Bishop's Falls, escapements to Great Rattling Brook and the tributaries of the middle Exploits after angling were monitored at the Camp I fishway and the Grand Falls collection facility respectively. There was no licensed recreational fishery above Camp I fishway.

Biological stock characteristic data were obtained from all brood fish at Noel Paul's Brook during allocation in September of each year. Overall representativeness of these data has to be viewed in terms of the manner in which brood were collected each year. For Adies Stream and Great Rattling Brook, collections were confined to the period from the beginning of the run until sufficient fish for incubation facility requirements were met and not spread out over the entire run. From 1974 to 1979, all fish collected at Grand Falls were transferred to the incubation facility. In 1980 and 1981, brood fish were collected from Grand Falls in connection with preliminary stocking of the upper Exploits in the same manner as described above for Adies Stream and Great Rattling Brook. Stock characteristic data for Bishop's Falls (1963) were available from nearly the entire run enumerated at that facility. Only specimens possessing scales suitable for life-history interpretations and ageing were considered for use in the present report. All fish in this category in each sample were utilized except for Grand Falls in 1979, 1980, and 1981 when sub-samples of approximately 100 fish were randomly drawn from all those available. Although length and weight measurements and sex ratio data were available for all years for Adies Stream, scale samples were only taken in 1967 and 1974.

RESULTS

EGG TO FRY SURVIVAL

Table 4 shows egg to fry survival for the spawning channel and incubation boxes separately and combined. Survivals are broken down in terms of each spawning section of the channel and each incubation box in Appendix 1. Overall survival for the channel prior to incubation box installation ranged from 33.4% in 1974/75 to 69.6% in 1969/70; the mean was 55.8%. Survival for individual spawning sections ranged from 3.0% (1974/75) to 46.4% (1972/73) for riffle 1, 31.7% (1974/75) to 75.9% (1972/73) for riffles 2 and 3 and 40.7 (1974/75) to 71.1% (1973/74) for riffles 4 and 5. After incubation box installation, a general increase in the channel survival rate was noted (sometimes exceeding 100% such as occurred in 1975/76). The combined effects of the following factors could have resulted in these anomalous values: (1) premature emergence of fry (see below) prior to installation of incubation box Wolf traps, (2) failure to remove all females in excess of spawning requirements associated with the holding of extra fish to ensure an adequate number of males (seining efficiency was hampered by the drain pipe from the incubation boxes running down the center of holding pools 1 and 2) and (3) some spawning was evident around the edge of holding pool 1 which contained fish for the incubation boxes. A number of partially spent fish were encountered each year from this pool during stripping. Survival for the two incubation boxes combined ranged from 67.4 (1978/79) to 83.5% (1976/77); the mean was 76.0%. Survival for incubation box 1 ranged from 69.7 (1978/79) to 82.4% (1976/77); the mean was 76.8%. The range for incubation box 2 was 63.3 (1975/76)-84.6% (1976/77) with a mean of 75.2%. If survivals from 1967/68 - 1974/75 are taken as representative of the spawning channel, it is evident that this method of incubation overall is substantially less efficient than the incubation box method. For the spawning channel and incubation boxes combined, survival ranged from 77.5 (1977/78) to 85.7% (1979/80); the mean was 82.1%.

DAILY FRY COUNTS

Daily fry counts from 1970 to 1980 for the spawning channel and incubation boxes separately and combined are shown in Fig. 11. Counts for each drop structure of the channel, for each incubation box and the total facility output are presented in Appendix 2a-k. Temperature data are included for 1976 and 1977. The peak emergence period showed variability over the years occurring anywhere from the first through the last week in June. In 1970 and 1971, Wolf traps were installed at each channel drop structure in the third and second week of May respectively; a few emerging fry were noted at that time. In subsequent years, Wolf traps were not installed until early June. On some occasions, small numbers of emerging fry were observed immediately after installation while on others it occurred a few days later. The great majority of the first fry emerging from the channel had yolk sacs entirely resorbed. When Wolf trap were installed for the incubation boxes (early June), varying numbers (upwards of 1,000-2,000 daily) of prematurely emerging fry (i.e. still with substantial yolk sacs) were generally encountered for a period of about one week. These fry were placed back into the incubation boxes. Lights were kept on constantly over this period as a means of retarding premature emergence. Distribution did not begin until yolk sacs were completely resorbed.

SMOLT RUNS

Daily and weekly smolt counts at the Bishop's Falls forebay from 1972 to 1981 are shown in Fig. 12 and Fig. 13 respectively (mean daily and weekly temperatures are included). Actual counts as well as temperature and water height values are presented in Appendix 3a-j (daily) and Appendix 4a-j (weekly). Depending on the year, peak movement generally occurred either in early, middle, or late June. In 1974, 1976, and 1977, runs were characterized by two distinct peaks separated in time by between two weeks and one month.

The total number of smolts counted through the forebay each year from 1972 to 1982 is shown in Table 5. A substantial increase was noted in 1979 (see also Figs. 12 and 13). This corresponded to the 3+ smolts emanating from the first year (1976) of the greatly increased levels of fry stocking on the middle Exploits (Table 5). However, the lower Exploits most likely also contributed substantially to the run since the adult escapement in 1975 (which produced fry in 1976) showed a marked increase over previous years (Fig. 14). Adult runs to the lower Exploits from 1976 to 1982 were lower than 1975 but still substantially higher than levels recorded prior to that year. This combined with the increased production from the middle Exploits appears to have resulted in continued high smolt counts at the forebay for all years subsequent to 1979 except 1980. In that year, labour problems forced mill closure and consequently shut-down of all turbines for a large portion of the run; also, record high water levels prevented flashboard installation. The combined effect was that considerably fewer smolts were trapped in the forebay. The return of grilse in 1981 (see below) indicates that the 1980 smolt run was probably of the same magnitude as observed in 1979 and 1981. This is commensurate with the number and density of fry stocked in 1976, 1977, and 1978 which was fairly similar each year. The number of smolts counted in 1982 (53,111) was similar to that of 1981. However, given a modal smolt age of 3+ years (see below), the count corresponded to only 677,638 fry stocked in 1979 (fry were distributed form the incubation boxes only since the spawning channel was not stocked with eggs in 1978 due to repair work), less than half the number stocked in 1978 corresponding to the 1981 smolt run (Table 5). The escapement to the lower Exploits in 1978 was the lowest in 4 years (Fig. 14) so the relative contribution to the smolt run from that source would be expected to have been lower than previous years. Two possible reasons for the unexpected large number of smolts counted in 1982 include (1) survival to the smolt stage could have been unusually high and/or, (2) operations at the Bishop's Falls forebay (described in detail in the foregoing) might have resulted in a relatively higher number of smolts than usual being captured. Because of operational procedures at the Bishop's Falls forebay, it is doubtful if the periodicity exhibited by the smolt samples taken at this facility (Figs. 12 and 13) are representative of the great majority passing over the dam on either a daily or weekly basis. Also, some caution should be exercised in using the total number of smolts counted each year as an index of the magnitude of the total run from the river.

KELTS

Daily and weekly counts of kelts at the Bishop's Falls forebay are presented in Appendix 3a-j and 4a-j respectively. The number counted ranged from 180 (1973) to 1,822 (1980). The expected increase in the number of kelts in 1981 as a result of the increased adult run to Grand Falls in 1980 (see below) did not materialize. It was suspected that some kelts might leave the Exploits soon after spawning and during the winter months.

ADULT RETURNS

Daily and weekly counts of adults at the Grand Falls collection facility from 1974 to 1981 are shown in Fig. 15 and Fig. 16 respectively (mean daily and weekly temperatures are included). Actual counts and temperature values are shown in Appendix 5a-h (daily) and Appendix 6a-h (weekly). Traditionally, adults encountered at fishways on the Exploits River which measured ≥62 cm were designated as large salmon (multi-sea-winter fish) while those <62 cm were categorized as grilse (1-sea-winter fish). As shall be seen in the next section, scale analysis showed that a clear-cut distinction on the basis of length measurement is not appropriate for Exploits River fish. However, in keeping with the manner in which counts were recorded over the years, in the presentation to follow, adults will be categorized as those < or ≥62 cm without the large salmon or grilse designation. Runs lasted from early July to September. First adults ≥62 cm in length generally appeared a few days after those <62 cm. Peaks for both size categories were somewhat coincident and occurred from mid-July through early August. The timing of the runs at the Grand Falls collection facility was usually 7-10 days later than at the Bishop's Falls fishway.

The maximum number of adults (<62 cm) returning to the Grand Falls collection facility, that resulted from fry stocking from the channel alone, occurred in 1979 (Table 5). Given a modal smolt age of 3+ years (see later), most of these fish corresponded to the 1975 fry stocking which was the lowest in terms of both number and density for the period 1970-75. Although lowest stockings occurred in 1968 and 1969, these years cannot be assessed in terms of adults since they would have returned prior to completion of the collection facility in 1974. The number of smolts counted at the Bishop's Falls forebay in 1978 was lower than in all previous years (bearing in mind, of course, the constraints placed on the forebay count outlined above). This suggests that marine survival of 1978 smolts might have been higher than that experienced prior to that year. In addition to or apart from good smolt survival, an important contribution to the 1979 count could have been adults corresponding to the first 2+ smolts resulting from the expanded fry stocking in 1976 (see below).

The first major return of adults (<62 cm) corresponding to the expanded fry stocking in 1976 ocurred in 1980 (Table 5, and Figs. 15 and 16). This amounted to a substantial increase over previous years. A substantial increase in the number of fish ≥62 cm in length was recorded in 1981; also that year the number of adults <62 cm showed an increase over 1980. In 1982, the number of fish in both size categories showed a decline. The smolt count at the Bishop's Falls forebay in 1981 indicates that the adult escapement should have been comparable with the previous two years. It is felt that the lower escapement does not reflect some factor or factors associated with fry stocking in 1978 compared to 1976 and 1977 since the count on Great Rattling Brook, where natural spawning occurs, also showed a similar decline in 1982 (Fig. 14). One possible explanation is poor marine survival. It is quite possible that adult returns in 1983 will be lower, since as already mentioned, the number of fry stocked in 1979 was less than one-half the number stocked from 1976 to 1978. If on the other hand, the smolt count at the Bishop's Falls forebay in 1982 is truly indicative of the entire smolt run for that year, then the level of returns should be comparable to the previous three years.

BIOLOGICAL STOCK CHARACTERISTICS

Length frequency distributions for grilse, large salmon and previous spawners for Bishop's Falls (1963), the Adies Stream donor stock (1967 and 1974), the Great Rattling Brook donor stock (1975-79) and for Grand Falls (1974-81) are presented in Fig. 17. Modal length of large salmon was generally higher than that of previous spawners which in turn was higher than that of grilse. The same trend was noted for mean length for all samples except Adies Stream in 1967 where the reverse occurred. Modal and mean length of Adies Stream grilse were higher than those recorded for offspring of that stock returning to Grand Falls from 1974 to 1979 (i.e. if one takes the 1967 and 1974 values for Adies Stream as probably applying to intervening years for that stock). In years when Great Rattling Brook and Grand Falls were sampled concurrently (1975-79), mean length of grilse was slightly higher for the former. Mean length of grilse returning to Grand Falls in 1980 and 1981 was slightly lower than that of Great Rattling Brook donor fish in 1975 and 1976 respectively (some Grand Falls fish also served as brood in those years as already pointed out).

Modal length of Great Rattling Brook grilse remained consistently the same each year sampled. The mode for Grand Falls grilse was the same as that of Great Rattling Brook except for 1976 and 1981 when it was lower. For a given sampling area, mean length of grilse showed slight variation from year to year. Mean and modal length of previous spawners showed variability with sampling area and sampling time. In the case of large salmon, the low numbers encountered do not allow for meaningful comparisions between areas and sampling times.

In several cases (Fig. 17), considerable overlap in range of length was noted for the grilse, large salmon and previous spawner categories. This was best demonstrated by the Bishop's Falls (1963) sample. It is obvious that the use of a 62 cm marker installed in fishway traps is of limited value for distinguishing between grilse and large salmon on the Exploits River; the situation is confounded even further by the intermediate length range of previous spawners.

It is evident from Table 6 that the great majority of adults returning to the Exploits River were grilse. The highest percentage of large salmon recorded was for the Adies Stream donor stock in 1967. Of the large salmon encountered, nearly all were 2-sea-winter fish (Figs. 18 and 19). The highest proportion of previous spawners recorded was in 1976 for Great Rattling Brook and Grand Falls; correspondingly these years marked the lowest proportion of grilse. With a few exceptions, all previous spawners returning to the Exploits River each year were consecutive spawning grilse; the exceptions occurred in 1975 and 1978 when 66.6 and 11.8% of the total respectively were found to be alternate spawning grilse. Of the small number of previous spawners in the Adies Stream sample in 1967, 50% were alternate spawning grilse, 25% were consecutive spawning multi-sea-winter fish and 25% were consecutive spawning grilse; in 1974, a single consecutive spawning multi-sea-winter fish was encountered.

Smolt age composition as determined from adult scales is shown in Figs. 18 and 19. Overall the dominant smolt age group for fish returning to the Exploits River was 3+ years; the range was 2+-6+ years. Exceptions occurred in smolt years 1973 and 1974 for Great Rattling Brook (Fig. 18) when a mode of 4+ years was noted (determined from grilse). The 4+ mode for 1974 was corroborated by age composition determined from smolt samples taken at Noel Paul's Brook and the Bishop's Falls forebay (Fig. 20) in that year. Fig. 20 also shows smolt age composition for Stoney Brook (a tributary of the lower Exploits) in 1970, 1971, and 1973 and for the Bishop's Falls forebay in 1977. The 1977 forebay sample showed general agreement with grilse returning to Great Rattling Brook and Grand Falls one year later in 1978 with respect to the 3+ and 4+ age groups. Mean smolt age (based on grilse) for Great Rattling Brook ranged from 3.19 (1978) to 3.95 (1974) years; the range for Grand Falls was 3.01 (1978)-3.73 (1974) years. Smolt age composition for Adies Stream adults for the two years sampled showed an overall similarity to that of Great Rattling Brook and to fish returning to Grand Falls (based on grilse, smolt age ranged from 2+ to 5+ years; modal smolt age ranged from 3+ to 4+ years; mean smolt age ranged from 3.06-3.61 years).

In addition to the substantial increase in the numbers of smolts encountered at the Bishop's Falls forebay, expanded fry stocking of the middle Exploits appears to have impacted on the smolt age composition of adults returning to Grand Falls (Fig. 19). In 1978 there was a marked increase in the number of 2+ smolts for Grand Falls. This corresponded to the 2+ smolts arising from the first year of increased fry stocking in 1976. In 1979, the 3+ mode was exceptionally strong while the relative percent composition of the 4+ age group was substantially lower than previous years. The first 3+ smolts resulting from the 1976 fry stocking obviously "swamped" the 4+ age group which corresponded to the lower level of stocking in 1975. In 1980, the first 4+ smolts arising from the 1976 stocking were encountered and the usual relative proportion of the 3+ and 4+ age groups, as exhibited by the middle Exploits, was restored. The onset of the increased numbers of 2+ and 3+ smolts in 1978 and 1979 respectively, resulted in a lowering of mean smolt age for these two years compared with preceeding years; with the appearance of the 4+ age groups in 1980, mean smolt age increased.

Mean length at age as determined from a number of smolt samples taken at various locations on the Exploits River is shown in Table 7. Overall mean length ranged from 12.1 (2+ smolts) to 29.5 cm (5+ smolts). Mean length of 3+ smolts ranged from 12.5 to 17.2 cm; for 4+ smolts the range was 15.1-19.3 cm.

Sex ratios (female:male) for the Adies Stream and Great Rattling Brook donor stocks and adults returning to Grand Falls are presented in Table 8 (these are actual sex ratios determined prior to the adjustment referred to in the Materials and Methods section). No distinction was made between grilse, large salmon and previous spawners since as shown in Table 6, generally, grilse comprised in excess of 95% of adults. In the case of 1976, the exceptionally large number of previous spawners was found to have a sex ratio quite similar to that of grilse. The sex ratio of Adies Stream adults averaged over the period 1967-73 was 1.59:1; the range was 0.76:1 (1968)-2.11:1 (1971). The average from 1975 to 1979 for Great Rattling Brook was 4.63:1; the range was 3.23:1 (1975)-5.74:1 (1978). The sex ratio of offspring of Adies Stream fish returning to Grand Falls averaged over the period 1974-78 was 3.15:1 (range was 2.00:1 in 1974-8.50:1 in 1976) which was a substantial change from that of the donor. The year 1979 was not included in this average because as shown earlier, it contained some adults corresponding to 2+ smolts from the expanded stocking in 1976 utilizing Great Rattling Brook donor stock. The sex ratio of progeny of Great Rattling Brook stock returning to Grand Falls in 1980 and 1981 (5.00:1 and 3.57:1 respectively) was fairly similar to that of the donor as was the average for the two years (4.15:1). The sex ratio of two samples of smolt taken at the Bishop's Falls forebay in 1974 and 1978 was 2.81:1 and 4.00:1 respectively (Table 8).

THE IMPACT OF THE MIDDLE EXPLOITS STOCKING ON THE COMMERCIAL AND RECREATIONAL FISHERIES

Corresponding to the first year of adult returns to the expanded fry stocking of the middle Exploits (1980), there was a marked increase in the commercial catch and catch per unit effort in Section 07 (Fig. 21) of Statistical Area B (Table 9). The regressions of catch and catch per unit effort on year over the period 1974-82 were significant ($p<0.05$). The level of effort over the same time period remained much the same. The regression of effort on time was positive but not significant ($p>0.05$). The adult count at Grand Falls increased significantly with time ($p<0.05$) as did that of Bishop's Falls. The regression for Great Rattling Brook was positive but not significant ($p>0.05$), suggesting that the signficant increase at Bishop's Falls was due mainly to the impact of Grand Falls fish. In the Bishop's Falls regression, the years 1981 and 1982 were represented by partial counts; had full counts been available, the fit might have been better. The above regressions did not include the year 1975 which in the context of all other years appears to have been rather unusual (Fig. 14). The number of smolts counted at the Bishop's Falls forebay in 1974 (Table 5) was the highest for the low level stocking phase which could be indicative of higher than usual freshwater survival. The regressions of catch and catch per unit effort on effort were positive and significant ($p<0.05$ and $p<0.001$ respectively). The regression of catch per unit effort on effort was positive but not signficant ($p>0.05$).

Regressions of fishway counts (separate and in various combinations and incorporating recreational catch in some cases) on commercial catch in Section 07 for the period 1974-82 are presented in Table 10. The relationship between the Grand Falls adult count and commercial catch was positive but not significant ($p>0.05$); the same applied to the Great Rattling Brook count versus commercial catch. However, the regression of the combined count for these two fishways on commercial catch was significant ($p<0.05$). The relationship between the Bishop's Falls fishway count (partial counts used for 1981 and 1982) and commercial catch was positive and significant ($p<0.05$). The regression of the Grand Falls and Great Rattling Brook counts combined plus recreational catch on commercial catch was significant ($p<0.05$). The regression of the Bishop's Falls count plus recreational catch (total river escapement in all years except 1981 and 1982) on commercial catch was also significant ($p<0.05$).

Recreational catch, effort and catch per unit effort on the Exploits River (broken out in terms of the major areas of angling activity and totalled for the whole river) between 1974 and 1982 are presented in Table 11. Regressions of catch on time were all positive but none were significant ($p>0.05$). Effort increased significantly with time on the main stem of the Exploits below Bishop's Falls as did total effort ($p<0.01$). Stoney Brook showed an increase (not significant, $p>0.05$) while Great Rattling Brook showed an overall non-significant ($p>0.05$) decline in effort. Catch per unit effort on the main stem of the Exploits below Bishop's Falls showed a significant decline with time ($p<0.05$); there was also a decline for Stoney Brook and total catch but not signicantly so ($p>0.05$). The relationship for Great Rattling Brook was positive but not signficant ($p>0.05$). The regressions of total catch on total effort and total catch on catch per unit effort were positive and not signficant ($p>0.05$). However, the relationship between total catch per unit effort and total effort was negative and signficant ($p<0.05$). Regressions of fishway count on the numbers of fish taken in the recreational fishery from 1974 to 1982 are presented in Table 12. No significant relationships were found for any of the various combinations of fishway count and recreational catch ($p>0.05$). Negative relationships were observed for Great Rattling Brook count versus recreational catch.

DISCUSSION

The single most significant observation associated with the expanded fry stocking program on the tributaries of the middle Exploits was the substantial increase in numbers of adults returning to Grand Falls. Other pertinent observations include (1) substantially increased smolt counts at the Bishop's Falls forebay, (2) a change in smolt age composition corresponding to the sequential entry of age groups of the progeny of the expanded 1976 stocking into the smolt migration (as determined from adult scales) and (3) increases in the commercial catch in the Bay of Exploits.

In an earlier study of the relationship between Exploits River escapement and commercial catch in the Bay of Exploits (covering the period 1960-70), Farwell (1971) concluded that Section 07 was more homogeneous for Exploits River origin fish than Statistical Area B as a whole and the degree of homogeneity increased proceeding into the bottom of the Bay of Exploits towards the mouth of the river (based on tag returns from kelts). This author also reported a significant positive correlation ($p<0.05$) between Exploits River escapement (Bishop's Falls count plus total recreational catch) and commercial catch in Section 07 for the period 1960-70. In the present analysis, the lack of significance for the individual regression of Grand Falls and Great Rattling Brook counts on commercial catch could have been due to (1) the confounding effects of poaching most of which occurs above Bishop's Falls, (2) differences in catchability in the recreational fishery relative to the situation below

Bishop's Falls, and (3) possibly to straying in the case of Grand Falls (see below).

The fact that effort has changed little since 1974 suggests that yearly variations in catch depended on availability of fish. Farwell (1971) came to a similar conclusion for the period 1960-70. It should be pointed out that the effort column in Table 9 shows the total amount of licenced gear allocated each year. This does not necessarily mean that a given fisherman will use all of his gear. All things being equal, one could assume that the amount of gear used would be proportional to fishing success. However, several variables, exclusive of the availability of fish, acting either singly of in combination, could have a bearing on the number taken in the commercial fishery and hence the number escaping to the river as well as affect the proportion of allocated gear actually used. These include weather and ice conditions, degree of net fouling and timing of migration in relation to emphasis placed on the exploitation of other inshore commercial species. The possible effects of differences in by-catch levels on both legal catch and river escapements also have to be considered. Regardless of all of the complicating factors, regression analysis (overall) strongly suggests a definite positive relationship between river escapement and commercial catch based on availability of fish. If one adds to this the observations presented above for smolts it is reasonable to conclude that the great increase in the numbers of adults returning to Grand Falls resulted from the expanded fry stocking and not some factor(s) producing higher than usual releases of fish from the commercial fishery. If the latter were true, one would have expected to see a proportionate dramatic increase in Great Rattling Brook escapements.

Chadwick (1982a) found a significant positive correlation ($p<0.01$) between the Bishop's Falls fishway count and recreational catch; a positive relationship ($p<0.01$) was also found for the count at Great Rattling Brook versus recreational catch. Regressions in the present study were not significant ($p>0.05$); however, they were based on considerably fewer data points (corresponding to the period in which the Grand Falls collection facility was operational only) than used by Chadwick in his analysis ($N = 16$ for Bishop's Falls and $N = 14$ for Great Rattling Brook). Factors affecting catchability (water temperature, water levels, weather, etc.) from year to year could also be involved. Over the period 1980-82 there was a decline in budget resources allocated for the collection of angling statistics on the Exploits River. Consequently, the accuracy of these data might be somewhat affected. If indeed the trends prsented in Table 11 are reasonable indicators, then there is a distinct possibility that the present level of exploitation is too high. The level of effort reached in 1982 was the highest ever recorded for the Exploits and represented an increase of 30 and 28% respectively over 1980 and 1981. The opening of Great Rattling Brook above Camp I fishway to angling is certainly not recommended at this time, especially in view of the possible future use of this area as a source of brood for the proposed fry stocking of the entire upper Exploits outlined by Pratt (1982).

By applying the percentages presented in Table 6, one can calculate the number of grilse returning to Grand Falls each year; further, by apportioning grilse according to smolt age composition shown in Fig. 19, the number of returns corresponding to a given year of fry stocking can be determined.

Percent grilse returns to fry stockings for the period 1971 through 1975 were 0.053, 0.052, 0.049, 0.040, and 0.206 respectively; the mean was 0.071%. For the expanded phase, it was possible to calculate grilse returns for the 1976 fry stocking year only; however, this calculation was minus the contribution of those adults corresponding to 5+ smolts which judging from other years should be minimal. The value obtained was 0.219%. Based on returns in 1981 and 1982, it is reasonable to assume that the same level would apply more or less to the 1977 and 1978 fry stocking years as well. The great difference in percent grilse returns observed between Great Rattling Brook and Adies Stream donor stocks will be discussed below in terms of changes in exploitation, straying in relation to changes in pollution levels and to brood stock suitability (genetic factors versus environmental factors). It must be remembered, however, that a certain number of fish from Grand Falls, which were progeny of Adies Stream donor stock, were used as brood each year during the expanded stocking phase.

Based on present data, it does not appear that returning adults corresponding to each donor stock were differentially exploited in the commercial fishery (as already alluded to in the foregoing). Trends in the recreational fishery (given the data limitations referred to above) suggest that on the Exploits as a whole, exploitation was probably higher for the progeny of Great Rattling Brook stock. Stoney Brook flows into the main stem of the Exploits approximately 1.0 km below the Grand Falls collection facility on the same side of the river as that structure. Angling occurs in the vicinity of the mouth of this tributary. There was a general increase in catch and effort in this area from 1974 on (Table 11); however, it is not known what proportion of these fish belonged to Stoney Brook itself[1], were strays entering that brook from Grand Falls in the year of return plus possibly the progeny of strays from previous years (see below) or were interceptions of fish which would have eventually reached Grand Falls. The greatly increased runs to Grand Falls did not result in a corresponding increase in angled catch near Stoney Brook even in the face of increased effort (in fact catch per unit effort showed an overall decline). This suggests that Grand Falls strays and/or interceptions might not have contributed substantially to angling in this area; again factors affecting catchability have to be considered.

The Grand Falls collection facility is located immediately across the main stem of the Exploits from the Grand Falls pulp and paper mill. A source of major concern over the years was the possible deleterious effects of mill effluent on returning adults. Of particular interest was the possibility that the effluent was responsible for straying, especially up Stoney Brook. Three of the four mill sewers discharge effluent into the river between the mouth of this tributary and the collection facility. In an attempt to ascertain if straying did occur, 4,822 smolts were tagged (Carlin tags) and released on Noel Paul's Brook in 1978. A counting fence was placed on Stoney Brook in 1979 for

[1]Mercer (1974) stated that historically, Stoney Brook probably accounted for one-half of the production of the Exploits River. This suggests an annual escapement of approximately 500 adults based on counts at Bishop's Falls prior to the impact of the adult transfer to Great Rattling Brook (i.e. prior to 1962) (Fig. 14).

the purpose of recovering tagged fish. A total of 5 tagged adults were recovered and released at the Bishop's Falls fishway; of these, 3 turned up at Grand Falls. A total of 447 adults were counted at Stoney Brook before a washout (August 17) terminated fence operations. An estimated 250 more adults were observed in a pool below the fence prior to flooding. Among these was a fish that was tagged as a kelt at Noel Paul's Brook incubation facility (since the fish was not captured and the legend number taken it is not known whether it originated from Grand Falls or Great Rattling Brook). No fish tagged as smolts were recovered on Stoney Brook. Since the 2 remaining fish released at Bishop's Falls did not show up at Camp I fishway on Great Rattling Brook nor were they reported as being taken in the recreational fishery, it is assumed they strayed elsewhere on the lower Exploits, possibly up Stoney Brook after the fence washout (provided there was no mortality as a result of handling at Bishop's Falls). The number of tagged adults involved was small; nevertheless, a straying rate of 40% is implied. The three adults returning to Grand Falls had a smolt age of 3+ years which identified them as being progeny of Adies Steam donor stock and not the progeny of Great Rattling Brook donor stock; returning adults of Great Rattling Brook parentage possessed a smolt age of 2+ years in 1979. This is convincing evidence to the effect that returns to Grand Falls up to and including 1979 were the progeny of fry stocking and not strays from the lower Exploits. As a result of pollution abatement measures undertaken at the mill, adults returning to the Grand Falls collection facility for the period 1980-82 were exposed to substantially lower levels of suspended solids (wood chips and fiber) than previously recorded and a slight reduction in toxicity due to resin acids (J. Clarke, Environmental Protection Service, personal communication). Without tagged adults corresponding to this period, it is not known if the improved water quality had a differential effect on straying. Even had such a study been conducted, in view of the low number of adults returning to the 1978 tagging experiment, it is doubtful if comparison would have been meaningful. Pending more definitive studies, the whole question of the level of straying attributable to the mill effluent remains for most part unresolved.

Two differing viewpoints exist in the literature with respect to the relative importance of genetics and environment in the phenomenal navigational and homing ability of salmonids. While Gardner (1976) and Hasler et al. (1978) suggest that environmental factors alone are involved, others (Ritter 1975; Saunders and Bailey 1980; Saunders 1981; Stabell 1982) believe there is a genetic component. By analyzing Atlantic salmon tagging data for New Brunswick and Nova Scotia rivers published by Stasko et al. (1973) in terms of recovery in the sea, Stabell (1982) demonstrated that survival of hatchery fish was similar to that of wild fish and suggested that the greater recovery rate for the latter was related to navigational ability and not to survival. Bams (1976) was cited by Stabell as having made a similar observation for pink salmon (Oncorhynchus gorbuscha (Walbaum)). Ritter (1975) found that hatchery reared Atlantic salmon smolts released in rivers other than native rivers in New Brunswick and Nova Scotia, gave a clinal decrease in adult returns with distance from native rivers. He hypothesized that ocean migration routes vary with genetic stocks and are heritable; progeny of fish released at greater distances from native rivers would have more difficulty linking up with their natural migration routes than they would if released in streams near their native rivers. Attempts to restore Atlantic salmon to rivers in Maine were more successful when local stocks were used as opposed to foreign stocks (Saunders and Bailey 1980). Walker and Lister (1971) suggested that the direction of entry from the sea to the donor stream in relation to that of the recipient stream could be of importance in orientation of pink salmon. In contrast to the situation for Great Rattling Brook, Adies stream is far removed from the Exploits and the direction of entry from the sea to the Humber River (from the west) difffers from that of the Exploits River (from the northeast) (Fig. 1). It is generally accepted that olfaction plays a major role in the recognition of the home stream and also tributary of the home stream by salmonids (Wishby and Hasler 1954; Hasler 1966; Gardner 1976; Hasler et al. 1978; Stabell 1982; Sutterlin et al. 1982). Hasler et al (1978) maintain that the response to olfactory stimuli is acquired as a result of imprinting (a process of rapid, irreversible learning). Imprinting is believed to occur during the smolt stage (Carlin 1968; Gardner 1976; Hasler et al. 1978). Stabell on the other hand rejects the "imprinting" hypothesis and suggests that the response to olfactory stimuli is inherited and not learned. He states that it is difficult to imagine how the lowermost population in a water chain could avoid being imprinted also to the odor from other populations. If genetics were involved to a substantial degree on the Exploits River with respect to within river navigation, one would have expected to see most of the progeny of Great Rattling Brook donor fish return to that stream and not to Grand Falls. Fishway counts at both Great Rattling Brook and Grand Falls suggest that this is not so. On the Exploits there could possibly be some problems with orientation associated with pollution in general regardless of the basis for the response to olfactory stimuli. Sutterlin (1974) suggested that changes in water quality could impair response to environmental cues.

In a review of the literature on transplants of Atlantic salmon, Gardner (1976) showed that the majority of fish adopted the characteristics (age of smoltification, homing ability and ratio of grilse:large salmon) of popultions endogeneous to the recipient streams, suggesting of course a strong environmental influence. Saunders (1981) cited studies which demonstrate a genetic component for a number of traits in Atlantic salmon some of which include rate and patterns of growth, precocious sexual maturity in male parr, age at smoltification, age and size at sexual maturity (grilse versus large salmon) and as already discussed above, migratory behaviour at sea. Comparing Adies Stream donor stock with endogeneous Exploits River fish (Bishop's Falls and Great Rattling Brook samples), smolt age was similar while mean length of grilse was slightly lower for the Exploits. Smolt age of the progeny of Adies Stream was similar to that of both the donor and recipient; however, mean length of grilse was more characteristic of the recipient. A pronounced difference between Adies Stream donor fish and its progeny was the acquisition of a sex ratio similar to that of the Exploits River (i.e. as displayed by Great Rattling Brook) on the part of the progeny, namely an increase in the proportion of females. This could be related to a change in the incidence of male precocity. Dalley et al. (1983) examined several insular Newfoundland rivers and found the incidence of male precocity to be high in most; they attributed an observed sex ratio highly in favor of females for smolts and grilse to a high mortality of precocious male parr and smolts. These authors found precocious males to constitute 12.3% (age groups combined) of a sample of male parr taken from Rocky Brook (another tributary of the Humber River) compared with 57.0% for a sample from Tote Brook, a tributary of Great Rattling

Brook. Assuming these levels to be representative of the Humber and Exploits Rivers as a whole, the shift in sex ratio could therefore be explained by an increase in male precocity for the progeny of Adies Stream fish to levels more indicative of the Exploits and an associated increase in mortality. The increase in male precocity could in turn be related to an increase in growth rate for the progeny of Adies Stream donor stock on the Exploits. Leyzerovich (1973), Mitans (1973), Bailey et al. (1980), Saunders et al. (1982) and Dalley et al. (1983) suggest that the fastest growing male parr in an age group tend to attain sexual maturity.

The progeny of Adies Stream fish also differed from their parents with respect to the ratio of grilse:large salmon back to the river, as is shown in Table 6 (the fact that only two years of stock characteristic data were available for Adies Stream has to be considered as well as the manner in which sampling was conducted referred to earlier). The percentage of large salmon returning decreased to a level similar to Exploits River stock. Schiefer (1972) found that for the North Shore of the Gulf of St. Lawrence, an increase in the incidence of precocious males leads to an increase in the number of males returning as grilse which in turn results in a higher grilse:large salmon ratio. In Newfoundland, the incidence of precocity is high but in contrast to the situation for the North Shore of the Gulf of St. Lawrence, survival is very low, hence precocious males do not contribute substantially to the grilse:large salmon ratio (Dalley et al. 1983). The possible effects of parentage on the incidence of male precocity has been examined by Glebe et al. (1980). These authors reported that for matings involving various combinations of precocious parr, grilse and large salmon, the incidences of precocity were highly variable and did not appear to be related to specific ages at maturity. This tends to suggest that other than directly contributing to the grilse population through high survival as reported by Schiefer (1971) for the North Shore of the Gulf of St. Lawrence, male precocity might not be related to the grilse:large salmon ratio. A comprehensive review of factors (both genetic and environmental) which could affect sea age of Atlantic salmon has been provided by Gardner (1976). As already pointed out, this author reviewed the literature on transplants and found that the progeny of transplanted fish adopted the grilse:large salmon ratio of the recipient streams.

To summarize briefly, taking possible differential effects of changes in exploitation and pollution abatement measures aside, while there is some suggestion that Great Rattling Brook donor stock might have been better suited genetically than Adies Stream donor stock with respect to navigational ability, there is evidence that other traits manifested in the progeny of transplanted Adies Stream fish were environmentally determined to a large extent. Saunders (1981) states that whereas many workers have attributed obvious differences among salmon from different rivers largely or entirely to environmental influences, it is currently accepted that both environmental and genetic factors are responsible for such differences as well as others which are more subtle. A study cited by Saunders which can exemplify some of the more subtle differences is that of Riddell et al. (1981) who, on the basis of breeding experiments, concluded that hereditary variation in body morphology (namely a more fusiform body) and a directional selection for greater fin size in a high water velocity as opposed to a low velocity environment, support a hypothesis that these traits are adaptive. With respect to management implications, these authors stressed the need to delineate stocks on a functional basis so as to prevent significant loss of fitness and/or depletion of genetic variation in natural populations. The obvious implication from this is that when undertaking the introduction of anadromous salmon into previously uninhabited areas, every consideration should be given to the possible role of genetics and, in order to ensure maximum success, donor fish should be obtained from localities comparable to the new environment, as suggested by Møller (1970). To single out one trait in particular, the possible influence of genetics on orientation should be of prime concern when choosing a brood source for a sea ranching venture (Thorpe 1980) such as the Exploits River Development. The Adies Stream donor stock was chosen because after consideration of several possible wild donor sources, it was the only stream identified as possessing a surplus of spawners (based on the egg deposition rate recommended by Elson (1957b) for Pollett River, New Brunswick). It was not feasible at that time to take brood fish from the lower Exploits, especially Great Rattling Brook since that stream itself was in the early stages of development. Incubation box installation in 1975 coincided with the greatly increased run to Great Rattling Brook which then became the major donor source. All things considered, adult returns to both transplants can be termed successful in a biological sense; the difference between them was one of degree. However, in terms of economics, benefits accruing to the Adies Stream transplant fell substantially short of the Great Rattling Brook transplant.

Nonanadromous Atlantic salmon are widespread throughout the entire Exploits River system. Payne (1974) compared the frequency of Tf_4 transferrin allele in a sample of nonanadromous salmon above Grand Falls on the Exploits with that of a sample of anadromous salmon below the falls. The frequency for the nonanadromous population was 0.81 whereas for anadromous salmon it was 0.13. In view of such a demonstration of genetic divergence between anadromous and nonanadromous populations (which occurred subsequent to the production of upstream migrational barriers by postglacial crustal recovery), this author recommended that the management practice of removing natural obstructions be reconsidered in the case of river systems which contain large stocks of nonanadromous salmon. He stated that an initial increase in smolt production after obstruction removal is no guarantee that the operation is a success since the increased smolt runs might be mainly F_1 hybrids behaving anadromously. Most mature hybrids would be genetically nonanadromous and most F_1 hybrids would backcross with them eventually resulting in the absorbtion of the small anadromous stock into the gene pool of the much larger nonanadromous stock. The long-term results demonstrated by adult returns to Great Rattling Brook (Fig. 14) indicate that the possible swamping of the gene pool of the colonizing anadromous population by the very much larger genetically integrated nonanadromous population as suggested by Payne (1974) has not occurred and indeed the reverse might be true.

Stocking densities on Noel Paul's Brook between 1968 and 1975 followed recommendations in Sturge (1968) which were based on studies at Indian Brook, Newfoundland. Rietveld et al. (1971) found that increasing the density of fry from 90 to 180/100 m^2 (both a substantial increase over Sturge's stocking densities) resulted in a corresponding increase in the number of 2+ parr produced. High water levels prevented assessment of these stocking levels in terms of smolts. Since the majority of smolts on Indian Brook are 3+, it is reasonable to assume that higher smolt production would have resulted from the higher stocking density. Based on these preliminary results and a goal to maximize production from the amount of suitable rearing habitat available, thereby increasing cost effectiveness, beginning in 1976 stocking densities on the middle Exploits were increased to the levels shown in Table 3. The high cost of operating counting fences precluded assessment of the stocking density on each tributary in terms of smolt production and also adult returns on a tributary basis. For plantings involving late summer hatchery reared underyearlings, Elson (1975) suggested that optimal smolt production would be achieved by a stocking density of about 48/100 m^2 (based on findings for Pollett River, New Brunswick). Gee et al. (1978) estimated the optimum initial stocking density for unfed fry on the River Wye in Scotland to be 100/100 m^2, which was considerably lower than previously recommended densities (200-500 fry/100 m^2) for British streams; they found maximum smolt production to be attained from a density of 75 fry/100 m^2 surviving to June 1. Egglishaw and Shackley (1980) reported survival at the end of the first growing season for unfed fry planted in May to range from 9.4 to 31.0% for Fender Burn in Scotland; these fry were stocked at densities ranging from 360 to 2,930/100 m^2, considerably higher than any planted on the Exploits. Instantaneous mortality rate increased with stocking density (range was 0.81-1.44%/day). Survival from the end of the first growing season to 1+ years of age ranged from 22 to 88%. Growth rate was negatively correlated with stocking density. Kennedy (1982) estimated the overall summer holding capacity for a stream in Northern Ireland for salmon fry in the presence of salmon parr and trout to range from 103.3 to 120.2/100 m^2; in the absence of other fish this value increased to 229.8 fry/100 m^2. This author pointed out that the initial stocking density from which these values were derived was about 620 salmon/100 m^2 and that the minimum initial density required to achieve such summer densities was yet to be investigated. Compared to some of the above stocking densities, increasing the overall density on the Exploits quite possibly resulted in an increase in smolt production over the previous level of stocking to the extent that there was not unnecessary mortality of fry. It should be noted however, that the rivers cited above produce predominately 2+ smolts. Symons (1979) suggested that optimal egg deposition varies with smolt age. He estimated optimal egg deposition rates for smolt ages 1+ through 4+ from matrices based on space requirements, growth rates, juvenile densities and survival rates published in the literature; recommended deposition rates for optimal production of 2+, 3+ and 4+ smolts were 220, 165-220, and a minimum of 80 eggs/100 m^2 respectively. Sturge (1968) reported that egg to fry survival under natural conditions in an experimental section of Indian Brook ranged between 10 and 30% and that 20% appeared to be a reasonable estimate. Applying this survival rate to Symons' egg deposition values, equivalent values in terms of fry are 44, 33-44 and a minimum of 16/100 m^2 for smolt ages 2+, 3+, and 4+ respectively. Elson (1975) on the other hand recommended 168 eggs/100 m^2 for the Miramichi River, New Brunswick (which produces mainly 3+ smolts) regardless of smolt age; an equivalent value for fry using an egg to fry survival of 20% is 34/100 m^2. Obviously there is a fair amount of uncertainty in the literature as to what constitutes an optimal egg deposition rate or fry stocking density. In considering Elson's (1975) optimum egg deposition of 168/100 m^2 for the Miramichi River, Kennedy (1982) noted that the value was based on juvenile assessments which indicated a much lower holding capacity than he himself determined for Northern Ireland streams. Possible reasons advanced for this difference were less extreme climatic conditions in Northern Ireland, a greater degree of enrichment producing more abundant food fauna in Northern Ireland streams, differences in densities of other competing fish species, the fact that the assessment in Northern Ireland was carried out in a more suitable nursery habitat for juvenile salmon than the depth and flow regimes encountered in the Miramichi, or a combination of these factors. An obvious implication from this pointed out by Kennedy is that it is most unwise to extrapolate optimum stocking densities from one river system to another. The optimum stocking density of 240 eggs/100 m^2 recommended by Elson (1957b, 1975) for Pollett River, New Brunswick, is widely used in Eastern Canada. Chadwick (1982b) concluded that there is little evidence supporting this value and that in fact the optimum could be considerably higher in many rivers. He also warns against extrapolation because of the variability in salmon habitat between and within river systems. This was stated to be especially the case for many Newfoundland rivers where Elson's value, which was based on stream rearing habitat, may not apply because of extensive parr rearing in standing waters (for example Western Arm Brook).

Applying the 20% egg to fry survival of Sturge (1968) to the Exploits River, the average number of fry stocked for the period 1976-78 was equivalent to an egg deposition rate of 379/100 m^2. Egg deposition rates for adults returning to the middle Exploits from 1980 to 1982 as well as the mean for that period are shown in Table 13 (calculated using data on fecundity, sex ratio, mean weight of females and amount of accessible rearing area presented in the foregoing). If one accepts 20% egg to fry survival as being a reasonable estimate (bearing in mind that this value is most likely subject to annual variation), compared with the optimum egg deposition rates given by Elson (1975) for the Miramichi and Pollett Rivers, it would appear that on the whole the middle Exploits is adequately seeded if not overseeded in terms of the amount of habitat initially stocked. If the optimum deposition is higher as suggested by Chadwick (1982b), at least as high as the level established during fry stocking, then a shortfall of adults occurred for all years of returns except 1981. Some factors acting either singly or in combination which could account for the deficiency of spawners include level of exploitation, level of poaching, straying rate and smolt to adult survival rate in the case of 1982 (all of which have been discussed above). Another contributing factor could be fry mortality as a function of the method of distribution. The brook trout has been reported as being a predator on Atlantic salmon fry and underyearling parr (McCrimmon 1954; Elson 1962; Sturge 1968). Mills (1964) and Symons and Heland (1978) report predation by salmon parr on fry. Egglishaw and Shackley (1980) and Kennedy and Strange (1980) on the other hand found very little evidence for predation on fry by older year-classes of salmon. Both juvenile anadromous Atlantic salmon and brook trout are territorial in behaviour (Keenleyside 1962; Gibson 1973). Initial plantings of anadromous fry on the Exploits were in the presence of established year-classes of landlocked salmon such as described by Farwell (1973). There have been no studies to determine whether or not landlocked salmon behave the same territorially as anadromous salmon (Gibson, personal communication). Gibson (1973) found that when anadromous salmon and brook trout occur sympatrically, the former are found mainly in faster water associated with riffle areas whereas the latter inhabit mainly the slower water of pools. Gibson (personal communication) suggested that upon release, fry could be in a weakened and disoriented condition as a result of the handling and transportation process and over the length of time that this condition persists they could be more prone to predation than is usual for fry dispersing naturally in rivers. On the Exploits, releases of fry were conducted mainly on riffles. If both landlocked salmon and anadromous salmon were interactively segregated from brook trout on the Exploits in a manner similar to that reported by Gibson (1973), older parr could have taken advantage of a lessened ability on the part of fry to avoid predation on the riffles while brook trout could have done the same for fry drifting downstream into pools due to a weakened condition having prevented their maintaining position on the riffles. Gibson (personal communication) suggested that releasing fry in shallow slow velocity areas away from riffles and pools would probably allow time for fry to acclimate to new surroundings and prevent drifting downstream thereby lessening the likelihood of pedation such as described above. Another predator to be contended with on the Exploits is the American eel which has been observed by Elson (1957a) to prey upon fry and parr. Additional fry mortality associated with the method of distribution could be related to the rate of dispersal from planting sites. Elson (1962) observed that ten weeks following planting, fry had distributed themselves 0.8 km above and 1.6 km below release points on Pollett River, New Brunswick. Sturge (1968) found that over a period of 1.5 to 3 months, fry released from the spawning channel on Indian Brook, Newfoundland limited their dispersal to within 3.2 km from the point of release (movement was predominantly downstream and the number caught per trap decreased with increased distance downstream). Kennedy (1982) reported downstream movement to be limited to around 0.33 km (number of fry followed an exponential decline pattern with distance downstream between May and late August) with little upstream movement. This author contended that Elson's observations were based on hatchery reared fry planted at the end of August and that they would show a greater tendency to disperse than newly emerged fry from redds. He suggested that slamon stocked out as swim up fry do not disperse as far as fry emerging from a redd; this was believed to be related to the limited yolk sac available at the time of planting and the possibility that mortality would result if territories were not established quickly. Along the same lines, Egglishaw and Shackley (1980) observed that, compared with salmon planted out as eggs, unfed fry do not appear to disperse well when they have reached the stage of feeding on small invertebrates; they suggested that there must therefore be considerable dispersion in the late alevin stage before territories have developed. Kennedy (1982) recommended that fry should be distributed evenly throughout the entire stream habitat. Fry were released at discrete points on the Exploits and were expected to disperse according to the observations of Elson (1962) and Sturge (1968). Sturge's data indicate that although there was a decline in numbers of fry with distance downstream, the majority dispersed well within 0.8 and 1.0 km from the point of release. The release site interval on the Exploits was every 0.4 km which was well within these limits. Mortality resulting from the method of release in relation to ability to establish territories may not have been that great especially if one compares the densities stocked on the Exploits with those used by Egglishaw and Shackley (1980) and Kennedy (1982) which were considerably higher. Considering the extremely large number of fry stocked on the Exploits each year, even dispersal would have been impractical in terms of the time factor involved. During peak emergence, as many as 200,000-300,000 fry were encountered daily. Experience showed that these had to be distributed without delay after emergence in order to prevent high mortality.

Despite possible initial losses resulting from the method of fry distribution, overall in terms of adult returns to the middle Exploits, fry stocking was an effective and efficient use of brood stock. A comparison can be made with Great Rattling Brook where spawning occurs naturally. Egg depositions (calculated in the same manner as for the middle Exploits) for Great Rattling Brook for 1975, 1976 and 1977 were 10,515,286, 6,110,918, and 8,720,074 respectively; the mean for the three years was 8,445,426. Since adults were not sampled at Great Rattling Brook in 1980, 1981, and 1982, it is not possible to calculate the number emanating from each egg deposition year (smolt age composition, and relative percentages of grilse, large salmon and repeat spawners are needed). However, an idea of the percent adult returns to the various egg depositions can be obtained by dividing the average adult returns for 1980-82 (4,242) by the average total egg deposition for the period 1975-77 (8,445,426) and multiplying by 100; the result obtained is 0.05%. A comparable calculation for the middle Exploits, namely average adult returns for 1980-82 (3,161) divided by the average number of eggs incubated at Noel Paul's Brook for 1975-77 (1,856,084) multiplied by 100, yields a result of 0.17% which is 3.4 times greater than that of Great Rattling Brook. An average of 865 female spawners were utilized at Noel Paul's Brook incubation facility between 1975 and 1977. Assuming that the 0.05% value obtained above for Great Rattling Brook applies to the middle Exploits under natural spawning conditions, approximately 2,900 females would have been required to achieve the same production as that resulting from fry distribution.

Adults returning to Grand Falls since 1980 were those resulting from fry stocking. The last adults corresponding to the fifth and final year of fry stocking (1980) will return in 1984. Beginning in 1980, adults were transported around Grand Falls by tank truck and released to spawn naturally. It is assumed that these fish returned to their respective tributaries in numbers proportionate to the numbers of fry stocked. The first progeny of naturally spawning adults on the middle Exploits are expected in 1985. It is hoped that adults released on the middle Exploits will eventually colonize accessible areas of tributaries other than those intensively stocked (see Mercer 1974) and habitable areas of the main stem as well. River survey reports by Pratt and Mercer (1965) and Porter et al. (1974) indicate that for most part, spawning habitat is interspersed fairly well with rearing habitat throughout most of the entire middle Exploits. The extent that colonization will occur and indeed the future of runs established thus far will probably depend to a large extent on the intensity of industrial activity on the middle Exploits, particularly in relation to the logging industry.

The drainage area below Red Indian Lake dam constitues approximately one-half of the watershed area of the entire Exploits River system or some 5,600 km^2 (Taylor and Bauld 1973). To date anadromous Atlantic salmon have been introduced into a large portion of this area. The upper Exploits (drainages flowing into Red Indian Lake) (Fig. 2) remains to be developed. This area has an estimated annual production potential (before exploitation) of 66,000 adults (Pratt 1982).

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Table 1. Number of brood fish utilized at Noel Paul's Brook incubation facility and brood source.

Year	Brood Source	No. of Fish
1967	Adies Stream	225
1968	Adies Stream	365
1969	Adies Stream	436
1970	Adies Stream	393
1971	Adies Stream	479
1972	Adies Stream	509
1973	Adies Stream	507
1974	Adies Stream Grand Falls	414 28
1975	Great Rattling Brook (Camp I) Grand Falls	795 315
1976	Great Rattling Brook (Camp I) Grand Falls	995 129
1977	Great Rattling Brook (Camp I) Grand Falls	932 227
1978	Great Rattling Brook (Camp I) Grand Falls	579 94
1979	Great Rattling Brook (Camp I) Grand Falls	888 464

Note: Data for 1967-73 are from Pratt et al. (1974).

Table 2. The number of females allocated to each section of the spawning channel and incubation boxes, density of females in the channel and mean weight of females.

Spawning Year and Section	No. of Females	Area of Channel Utilized (m^2)	Density (m^2/Female)	$\bar{X}$ Weight of Females (gm)
1967				
Pool No. 2 and Pool No. 3 (Riffles 2, 3, 4, and 5)	113	1,134	10.0	1,552
1968				
Pool No. 2 and Pool No. 3 (Riffles 2, 3, 4, and 5)	146	610	4.2	1,232
1969				
Pool No. 2 (Riffles 2 and 3)	99	331	3.3	1,230
Pool No. 3 (Riffles 4 and 5)	133	556	4.2	1,230
1970				
Pool No. 2 (Riffles 2 and 3)	75	188	2.5	1,171
Pool No. 3 (Riffles 4 and 5)	167	558	3.3	1,205
1971				
Pool No. 2 (Riffles 2 and 3)	74	248	3.4	1,274
Pool No. 3 (Riffles 4 and 5)	223	559	2.5	1,283
1972				
Pool No. 1 (Riffle 1)	12	20	1.7	1,348
Pool No. 2 (Riffles 2 and 3)	125	418	3.3	1,213
Pool No. 3 (Riffles 4 and 5)	149	498	3.3	1,307
1973				
Pool No. 1 (Riffle 1)	20	34	1.7	1,249
Pool No. 2 (Riffles 2 and 3)	126	421	3.3	1,280
Pool No. 3 (Riffles 4 and 5)	107	358	3.4	1,442
1974				
Pool No. 1 (Riffle 1)	24	46	1.9	1,258
Pool No. 2 (Riffles 2 and 3)	125	418	3.3	1,394
Pool No. 3 (Riffles 4 and 5)	118	253	2.2	1,385
1975				
Pool No. 1 (Incubation Boxes)	478	-	-	1,289
Pool No. 2 (Riffles 2 and 3)	164	418	2.5	1,321
Pool No. 3 (Riffles 4 and 5)	213	559	2.6	1,312

Table 2 (cont'd.)

Spawning Year and Section	No. of Females	Area of Channel Utilized (m^2)	Density (m^2/Female)	$\bar{X}$ Weight of Females (gm)
1976				
Pool No. 1 (Incubation Boxes)	482	-	-	1,403
Pool No. 2 (Riffles 2 and 3)	167	418	2.5	1,423
Pool No. 3 (Riffles 4 and 5)	210	559	2.7	1,375
1977				
Pool No. 1 (Incubation Boxes)	500	-	-	-
Pool No. 2 (Riffles 2 and 3)	171	418	2.5	*1,401
Pool No. 3 (Riffles 4 and 5)	210	559	2.7	-
1978**				
Pool No. 1 (Incubation Boxes)	565	-	-	-
Pool No. 2 (Riffles 2 and 3)	-	-	-	-
Pool No. 3 (Riffles 4 and 5)	-	-	-	-
1979				
Pool No. 1 (Incubation Boxes)	700	-	-	-
Pool No. 2 (Riffles 2 and 3)	180	418	2.3	*1,407
Pool No. 3 (Riffles 4 and 5)	210	559	2.7	-
1980				
Pool No. 1 (Incubation Boxes)	553	-	-	-
Pool No. 2 (Riffles 2 and 3)	177	418	2.4	*1,400
Pool No. 3 (Riffles 4 and 5)	209	559	2.7	-

* Mean weight based on all females in channel prior to allocation

** Incubation boxes stocked only

Table 3. Total number of fry stocked, number of 100 m^2 units of habitat stocked and stocking density.

Year	No. of Fry Stocked	No. of 100 m^2 Units Stocked	No. of Fry Stocked/100 m^2
Spawning Channel			
Noel Paul's Brook			
1968	139,880	2,966	47
1969	157,870	2,966	53
1970	308,520	4,853	64
1971	283,246	8,331	34
1972	302,506	7,960	38
1973	390,689	8,139	49
1974	355,800	8,086	44
1975	202,110	8,084	25
$\bar{X}$	267,578	6,427	42
Spawning Channel + Incubation Boxes			
Noel Paul's Brook			
1976	802,633	10,662	75
1977	853,197	10,662	80
1978	839,514	10,662	79
1979*	595,412	9,133	65
1980	1,085,600	17,409	62
$\bar{X}$	835,271	11,706	71
Badger Brook			
1976	209,789	2,200	95
1977	205,742	1,911	108
1978	212,137	1,911	111
1979*	-	-	-
1980	275,659	2,828	98
$\bar{X}$	225,832	2,213	102
Little Red Indian Brook			
1976	155,453	2,550	61
1977	152,841	2,628	58

Table 3. (cont'd.)

Year	No. of Fry Stocked	No. of 100 m^2 Units Stocked	No. of Fry Stocked/100 m^2
Little Red Indian Brook			
1978	160,116	2,577	62
1979*	101,485	1,933	53
1980	168,083	2,577	65
$\bar{X}$	147,596	2,453	60
Tom Joe's Brook			
1976	102,187	1,923	53
1977	112,446	516	218
1978	107,589	416	259
1979*	-	-	-
1980	111,749	516	217
$\bar{X}$	108,493	843	129
Harpoon Brook			
1980	106,353	1,058	101
Junction Brook			
1980	66,890	423	158
Aspen Brook			
1980	13,040	105	124
Mary March Brook (Upper Exploits)			
1976	190,533	4,234	45
1977	178,478	3,966	45
1978	31,116	327	95
$\bar{X}$	133,376	2,842	47

Table 3. (cont'd.)

Year	No. of Fry Stocked	No. of 100 m^2 Units Stocked	No. of Fry Stocked/100 m^2
All tributaries combined			
1976	1,460,595	21,479	68
1977	1,502,704	19,516	77
1978	1,350,470	15,888	85
1979*	696,897	9,488	74
1980	1,827,374	25,030	73
$\bar{X}$	1,367,608	18,280	75

Note: Data for Noel Paul's Brook for 1968-73 are from Pratt et al. (1974).

* Fry distributed from incubation boxes only.

Table 4. Egg deposition, fry emergence and egg to fry survival for the spawning channel and incubation boxes separately and combined.

Year	Spawning Channel			Incubation Boxes			Channel and Boxes		
	Egg Deposition (No.)	Fry Emergence (No.)	Egg to Fry Survival (%)	Egg Deposition (No.)	Fry Emergence (No.)	Egg to Fry Survival (%)	Egg Deposition (No.)	Fry Emergence (No.)	Egg to Fry Survival (%)
1967/68	289,450	152,838	52.8	-	-	-	-	-	-
1968/69	296,822	162,409	54.7	-	-	-	-	-	-
1969/70	470,900	327,728	69.6	-	-	-	-	-	-
1970/71	476,931	302,769	63.5	-	-	-	-	-	-
1971/72	627,500	311,871	49.7	-	-	-	-	-	-
1972/73	598,192	398,985	66.7	-	-	-	-	-	-
1973/74	625,066	367,098	58.7	-	-	-	-	-	-
1974/75	607,756	202,888	33.4	-	-	-	-	-	-
1975/76	804,674	809,897	*100.6	1,037,457	701,540	67.6	1,842,131	1,511,437	82.1
1976/77	853,875	695,847	81.5	976,425	814,871	83.5	1,830,120	1,510,718	82.6
1977/78	866,000	628,528	72.6	1,030,000	840,534	81.6	1,896,000	1,469,062	77.5
1978/79	-	-	-	1,111,000	748,442	67.4	-	-	-
1979/80	882,000	826,902	93.8	1,275,000	1,021,971	80.2	2,157,000	1,848,873	85.7

Note: Data for 1967/68-1972/73 are from Pratt et al. (1974).

* See text

Table 5. The number of smolts counted at the Bishop's Falls forebay from 1972 to 1982 and the Grand Falls adult count from 1974 to 1982. Also shown is the total number of fry stocked each year on the Middle Exploits from the spawning channel (1968-75) and from the spawning channel and incubation boxes combined (expanded phase, 1976-80) as well as the number of 100 m^2 units stocked and stocking density.

Year	Total No. of Fry Stocked	No. of 100 m^2 Units Stocked	No. of Fry Stocked/100m^2	No. of Smolts (B.F. Forebay)	Grand Falls Adult Count		
					(<62 cm)	(≥62 cm)	Total
Channel							
1968	139,880	2,966	47	-	-	-	-
1969	157,870	3,036	52	-	-	-	-
1970	308,520	4,821	64	-	-	-	-
1971	283,246	8,331	34 $\bar{X}$=42	-	-	-	-
1972	302,506	7,961	38	9,939	-	-	-
1973	390,689	8,139	48	15,698	-	-	-
1974	355,800	8,086	44	22,141	64	0	64
1975	202,110	8,084	25	17,062	321	19	340
Channel + Incubation Boxes							
1976	1,460,595	21,479	68	16,420	125	4	129
1977	1,502,704	19,516	77	14,369	243	9	252
1978	1,350,470	15,888	85 $\bar{X}$=75	8,818	132	6	138
1979	696,897*	9,488	74	86,791	455	7	462
1980	1,827,374	25,030	73	20,931	3,060	13	3,073
1981	-	-	-	59,820	3,795	227	4,022
1982	-	-	-	53,111	2,321	67	2,388

Note: Fry stocking data for 1968-73 are from Pratt et al. (1974)

* Fry distributed from incubation boxes only

Table 6. Percent composition of grilse, large salmon and previous spawners. Numbers of fish in parentheses.

Area/Date		%		
		Grilse	Large Salmon	Previous Spawners
Bishop's Falls	1963	88.14 (981)	1.80 (20)	10.06 (112)
Adies Stream	1967	93.93 (201)	4.21 (9)	1.87 (4)
Adies Stream	1974	99.17 (239)	0.41 (1)	0.41 (1)
Great Rattling Brook	1975	99.87 (765)	0.13 (1)	0.0 (0)
Great Rattling Brook	1976	75.15 (641)	0.0 (0)	24.85 (212)
Great Rattling Brook	1977	97.89 (788)	0.0 (0)	2.11 (17)
Great Rattling Brook	1978	96.31 (444)	0.0 (0)	3.69 (17)
Great Rattling Brook	1979	99.28 (411)	0.0 (0)	0.72 (3)
Grand Falls	1974	100.0 (24)	0.0 (0)	0.0 (0)
Grand Falls	1975	97.90 (140)	0.0 (0)	2.10 (3)
Grand Falls	1976	73.68 (14)	0.0 (0)	26.32 (5)
Grand Falls	1977	98.03 (149)	1.97 (3)	0.0 (0)
Grand Falls	1978	100.0 (63)	0.0 (0)	0.0 (0)
Grand Falls	1979	98.99 (98)	0.0 (0)	1.01 (1)
Grand Falls	1980	100.0 (100)	0.0 (0)	0.0 (0)
Grand Falls	1981	95.19 (99)	1.92 (2)	2.88 (3)

Table 7. Mean length at age of smolts taken at various locations on the Exploits River.

Area/Date	Age	$\bar{X}$ Length (cm)	Standard Error	Range (cm)	N
[a]Stoney Brook					
1970	2+	12.1	-	-	2
	3+	15.2	-	-	67
	4+	16.3	-	-	27
	5+	18.4	-	-	2
1971	2+	13.5	-	-	10
	3+	15.8	-	-	33
	4+	17.8	-	-	8
	5+	29.5	-	-	1
1973	2+	13.5	-	-	2
	3+	14.6	-	-	51
	4+	15.5	-	-	41
	5+	18.1	-	-	4
[b]Noel Paul's Brook					
1974	2+	-	-	-	-
	3+	12.5	-	-	23
	4+	15.1	-	-	141
	5+	17.1	-	-	19
Bishop's Falls Forebay					
[b]1974	2+	-	-	-	-
	3+	15.5	-	-	34
	4+	19.3	-	-	56
	5+	17.9	-	-	9
1977	2+	15.0	0.476	13.8-17.4	7
	3+	17.2	0.095	13.3-23.9	299
	4+	18.5	0.212	14.2-24.5	113
	5+	20.1	1.867	17.2-23.6	3

[a]From Mercer and Anderson (1974)

[b]From Davis and Farwell (1975)

Table 8. Sex ratios for the Adies Stream and Great Rattling Brook donor stocks and adults returning to Grand Falls. The sex ratio of two samples of smolts taken at the Bishop's Falls forebay is also shown.

Area/Date		No. of Females	No. of Males	Ratio (F:M)
ADULTS				
[a]Adies Stream				
	1967	125	100	1.25:1
	1968	158	207	0.76:1
	1969	291	145	2.01:1
	1970	258	135	1.91:1
	1971	325	154	2.11:1
	1972	312	197	1.58:1
	1973	319	188	1.70:1
Great Rattling Brook				
	1975	710	220	3.23:1
	1976	894	161	5.55:1
	1977	992	176	5.64:1
	1978	413	72	5.74:1
	1979	373	101	3.69:1
Grand Falls				
	1974	24	12	2.00:1
	1975	214	39	5.49:1
	1976	17	2	8.50:1
	1977	151	75	2.01:1
	1978	57	19	3.00:1
	1979	83	20	4.15:1
	1980	95	19	5.00:1
	1981	100	28	3.57:1
SMOLTS				
B.F. Forebay	[b]1974	73	26	2.81:1
	1977	216	54	4.00:1

[a]From Pratt et al. (1974)

[b]From Davis and Farwell (1975)

Table 9. The individual regression of commercial catch, effort, and catch per unit effort for Section 07, Statistical Area B and adult count at the Grand Falls, Great Rattling Brook and Bishop's Falls fishways on year over the period 1974-82. Also shown are the regressions of catch on effort, catch on catch per unit effort and catch per unit effort on effort.

Year	Catch B-07 (kg)	Effort (No. Gear Units)	Catch Per Unit Effort	No. of Adults: Grand Falls	No. of Adults: Gt. Rattling Brook	No. of Adults: Bishop's Falls
1974	17,601	838	21.0	64	N.C.	2,994
[a]1975	54,222	1,142	47.5	340	6,556	10,451
1976	21,656	1,090	19.9	129	3,158	4,599
1977	33,968	994	34.2	252	4,515	6,642
1978	30,269	1,028	29.4	138	2,711	4,059
1979	17,024	943	18.1	462	4,042	6,969
1980	54,827	1,079	50.8	3,073	4,968	N.C.
1981	47,493	1,062	45.8	4,022	4,800	[b]10,710
1982	42,724	1,037	41.2	2,388	2,959	[b]7,787
	[1]r=0.73* df=6	[2]r=0.50 N.S. df=6	[3]r=0.72* df=6	[4]r=0.82* df=6	[5]r=0.03 N.S. df=5	[6]r=0.79* df=7

[1] $y = 14,211 + 4,219x$
[2] $y = 933 + 16.95x$
[3] $y = 15.98 + 3.68x$
[4] $y = -1,069 + 530x$
[5] $y = 3,560 + 79.64x$
[6] $y = 2,405 + 962x$

[b] = Partial Count
N.C. = No Count

* = Significant $p<0.05$
*** = Significant $p<0.001$
N.S. = Not Signifcant

[a]1975 not included in regressions 1-6

Catch on Effort: $y = -86,682 + 119.39x$ $r = 0.72$* df = 7
Catch on Catch per Unit Effort: $y = -4,465 + 1,169x$ $r = 0.99$*** df = 7
Catch Per Unit Effort on Effort: $y = 870 + 4.48x$ $r = 0.63$ N.S. df = 7

Table 10. The regression of fishway count (Grand Falls and Great Rattling Brook separate and combined and Bishop's Falls) on commercial catch in Section 07, Statistical Area B (1974-82). Regressions incorporating total recreational catch are also shown.

Regression	Formula	r	df
[1]G.F. on [2]B-07	y = -1,124 + 0.066x	0.65 N.S.	7
[3]G.R.B. on B-07	y = 2,076 + 0.057x	0.63 N.S.	6
G.F. + G.R.B. on B-07	y = 930 + 0.123x	0.81*	6
G.F. + G.R.B. + [4]R.C. (total) on B-07	y = 2,616 + 0.122x	0.80*	6
[5]B.F. on B-07	y = 1,226 + 0.168x	0.83*	6
B.F. + [4]R.C. (total) on B-07	y = 2,614 + 0.173x	0.82*	6

[1]Grand Falls Count
[2]Section 07, Statistical Area B - Commercial Catch (kg)
[3]Great Rattling Brook Count
[4]Total Recreational Catch (No.)
[5]Bishop's Falls Count
[6]Recreational Catch, Main Stem of Exploits Below Bishop's Falls Fishway (No.)

* = Significant $p<0.05$

N.S. = Not Significant $p>0.05$

Table 11. The individual regression of recreational catch, effort and catch per unit effort on year over the period 1974-82. Also shown are the regressions of total catch on total effort, total catch on total catch per unit effort and total catch per unit effort on total effort.

Year	Recreational Catch (No.)				Effort (Rod Days)				Catch Per Unit Effort			
	[a]E	[b]G.R.B.	[c]S.B.	Total	[a]E	[b]G.R.B.	[c]S.B.	Total	[a]E	[b]G.R.B.	[c]S.B.	Total
1974	792	194	-	986	2,656	1,276	-	3,932	0.30	0.15	-	0.25
1975	1,247	47	9	1,303	4,024	527	6	4,557	0.31	0.09	1.50	0.29
1976	1,651	222	61	1,934	4,394	1,194	187	5,775	0.38	0.19	0.33	0.33
1977	1,342	417	93	1,852	4,672	2,104	168	6,944	0.29	0.20	0.55	0.27
1978	990	241	249	1,480	4,160	483	388	5,031	0.24	0.50	0.64	0.29
1979	1,431	-	-	1,431	8,363	-	-	8,363	0.17	-	-	0.17
1980	1,417	164	209	1,790	5,731	784	912	7,427	0.25	0.21	0.23	0.24
1981	1,556	303	-	1,859	6,419	1,096	-	7,515	0.24	0.28	-	0.25
1982	1,519	132	82	1,733	8,680	650	300	9,630	0.18	0.20	0.27	0.18
	[1]r=0.57 N.S. df=7	[2]r=0.13 N.S. df=6	[3]r=0.56 N.S. df=4	[4]r=0.57 N.S. df=7	[5]r=0.84** df=7	[6]r=-0.24 N.S. df=6	[7]r=0.66 N.S. df=4	[8]r=0.88** df=7	[9]r=-0.74* df=7	[10]r=0.34 N.S. df=6	[11]r=-0.72 N.S. df=4	[12]r=-0.60 N.S. df=7

[1]y = 1,039 + 57.60x
[2]y = 188.43 + 5.91x
[3]y = 0.31 + 27.57x
[4]y = 1,268 + 65.78x
[5]y = 2,318 + 627.43x
[6]y = 1,249 - 52.24x
[7]y = -59.67 + 110.43x
[8]y = 3,542 + 606.48x
[9]y = 0.35 -0.02x
[10]y = 0.14 + 0.02x
[11]y = 1.22 - 0.18x
[12]y = 0.31 - 0.01x

[a]Main Stem of Exploits Below Bishop's Falls Fishway
[b]Great Rattling Brook
[c]Stoney Brook

* = Significant p>0.05
** = Significant p<0.01
N.S. = Not Significant p>0.05

Total Catch on Total Effort: y = 960.52 + 0.10x r = 0.57 N.S. df = 7
Total Catch on Catch Per Unit Effort: y = 1,390 + 817.64x r = 0.13 N.S. df = 7
Total Catch Per Unit Effort on Total Effort: y = 13,242 - 26.434x r = -0.73* df = 7

Table 12. The regression of fishway count on recreational catch for various locations on the Exploits River from 1974 to 1982.

Regression	Formula	r	df
[1]G.F. on [2]R.C. (total)	y = -2,472 + 2.31x	0.48 N.S.	7
G.F. on [3]R.C. (S.B.)	y = 595 + 3.914x	0.27 N.S.	4
G.F. on [4]R.C. (M.S.E.) + R.C. (S.B.)	y = -3,812 + 3.29x	0.50 N.S.	4
[5]G.R.B. on R.C. (total)	y = 6,973 - 1.650x	-0.30 N.S.	6
G.R.B. on [6]R.C. (G.R.B.)	y = 4,896 - 3.018x	-0.26 N.S.	5
G.R.B. on R.C. (M.S.E.) + R.C. (G.R.B.)	y = 5,567 - 0.827x	-0.15 N.S.	5
G.R.B. + G.F. on R.C. (total)	y = 3,680 + 1.267x	0.12 N.S.	6
[7]B.F. on R.C. (total)	y = 2,821 + 2.516x	0.29 N.S.	6

[1]Grand Falls Count
[2]Total Recreational Catch (No.)
[3]Recreational Catch, Stoney Brook Area (No.)
[4]Recreational Catch, Main Stem of Exploits Below Bishop's Falls Fishway (No.)
[5]Great Rattling Brook Count
[6]Recreational Catch, Great Rattling Brook (No.)
[7]Bishop's Falls Count

N.S. = Not Significant $p>0.05$

Table 13. Egg deposition rates for adults returning to the middle Exploits River from 1980 to 1982 as well as the mean for that period.

	1980	1981	1982	1980-82
Grand Falls Count	3,073	4,022	2,388	3,161
% Female	83.3	78.1	**80.6	**80.6
$\bar{X}$ Wt. of Females (kg)	1.40	1.40	1.40	1.40
Total Egg Deposition	5,812,814	7,132,996	4,370,672	5,785,467
$\bar{X}$ No. of Rearing Units* Stocked With Fry From 1976 to 1978	18,961	18,961	18,961	18,961
No. of Eggs/100 m^2	306	376	231	305

* One Unit = 100 m^2
** Mean Based on Data for 1980 and 1981 combined

Grand Falls Count x % Female = No. of Female Spawners

No. of Female Spawners x Mean Female Wt. = Total Wt. of Females

Total Wt. of Females x 1,622 Eggs/kg = Total Egg Deposition

Total Egg Deposition ÷ 18,961 Units = No. of Eggs/100 m^2

Note: There was very little angling above Grand Falls therefore fishway count essentially equals spawning escapement.

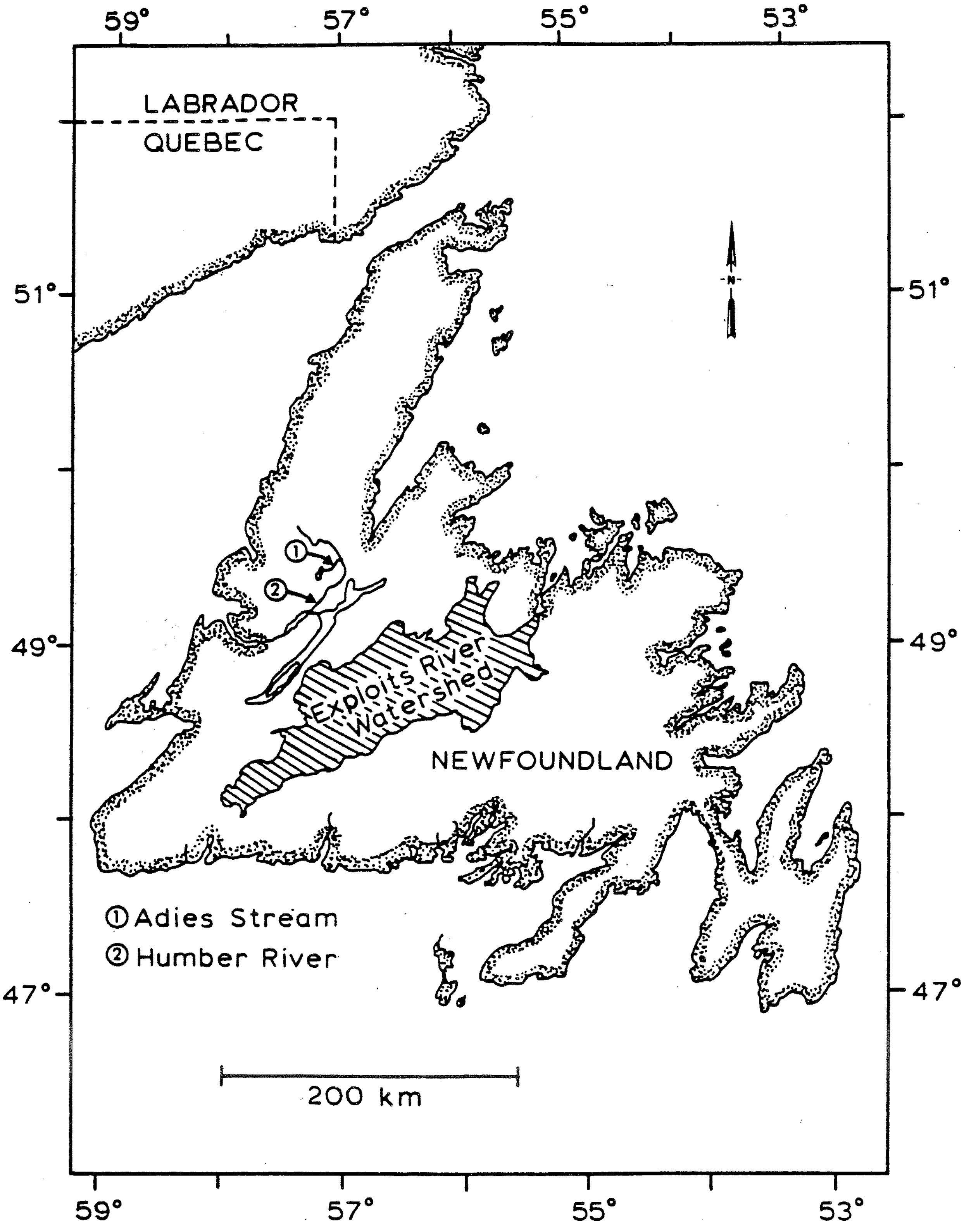


Fig. 1. Map of insular Newfoundland showing the extent of the Exploits River watershed.

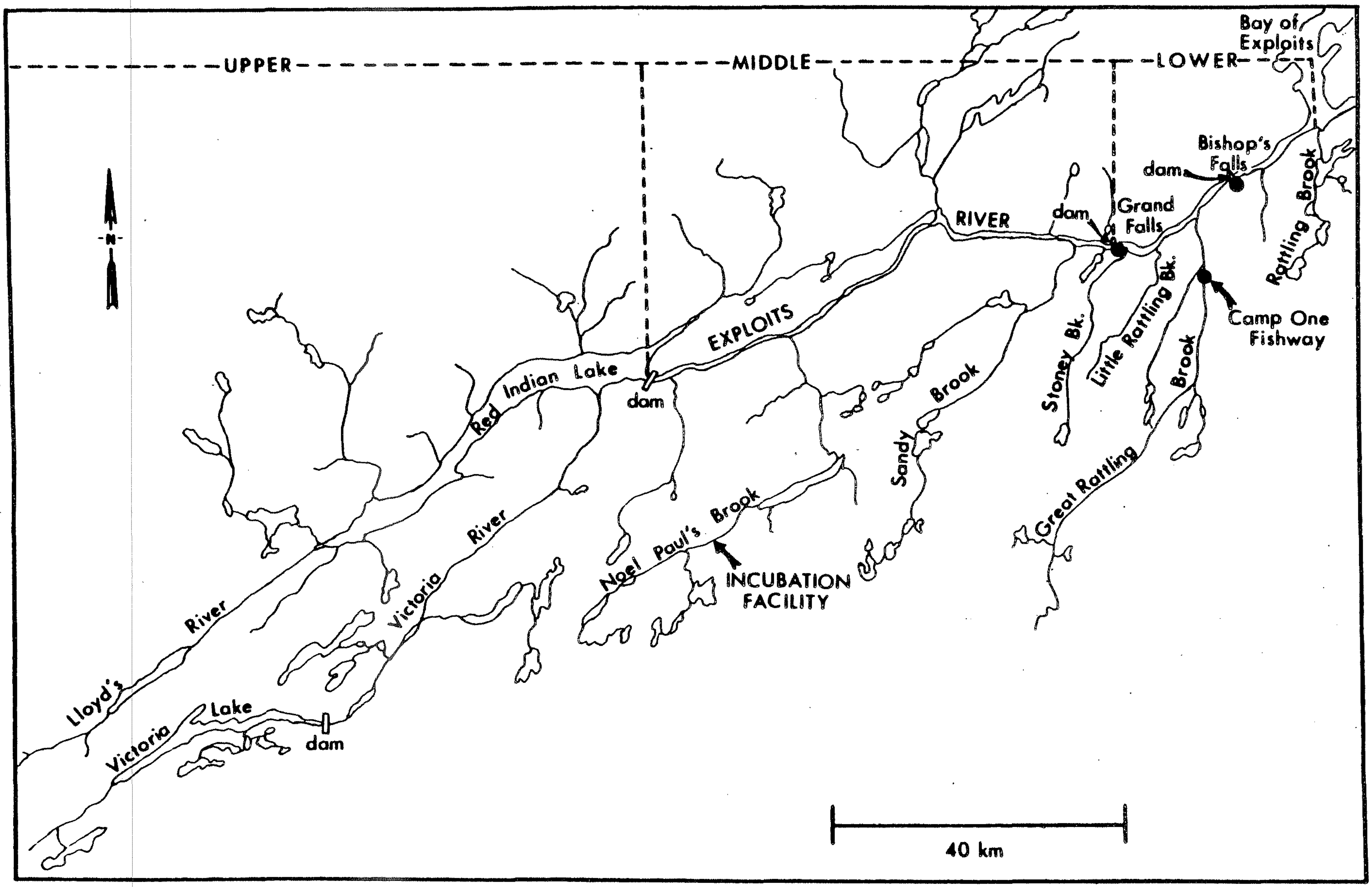


Fig. 2. Detailed map of the Exploits River system.

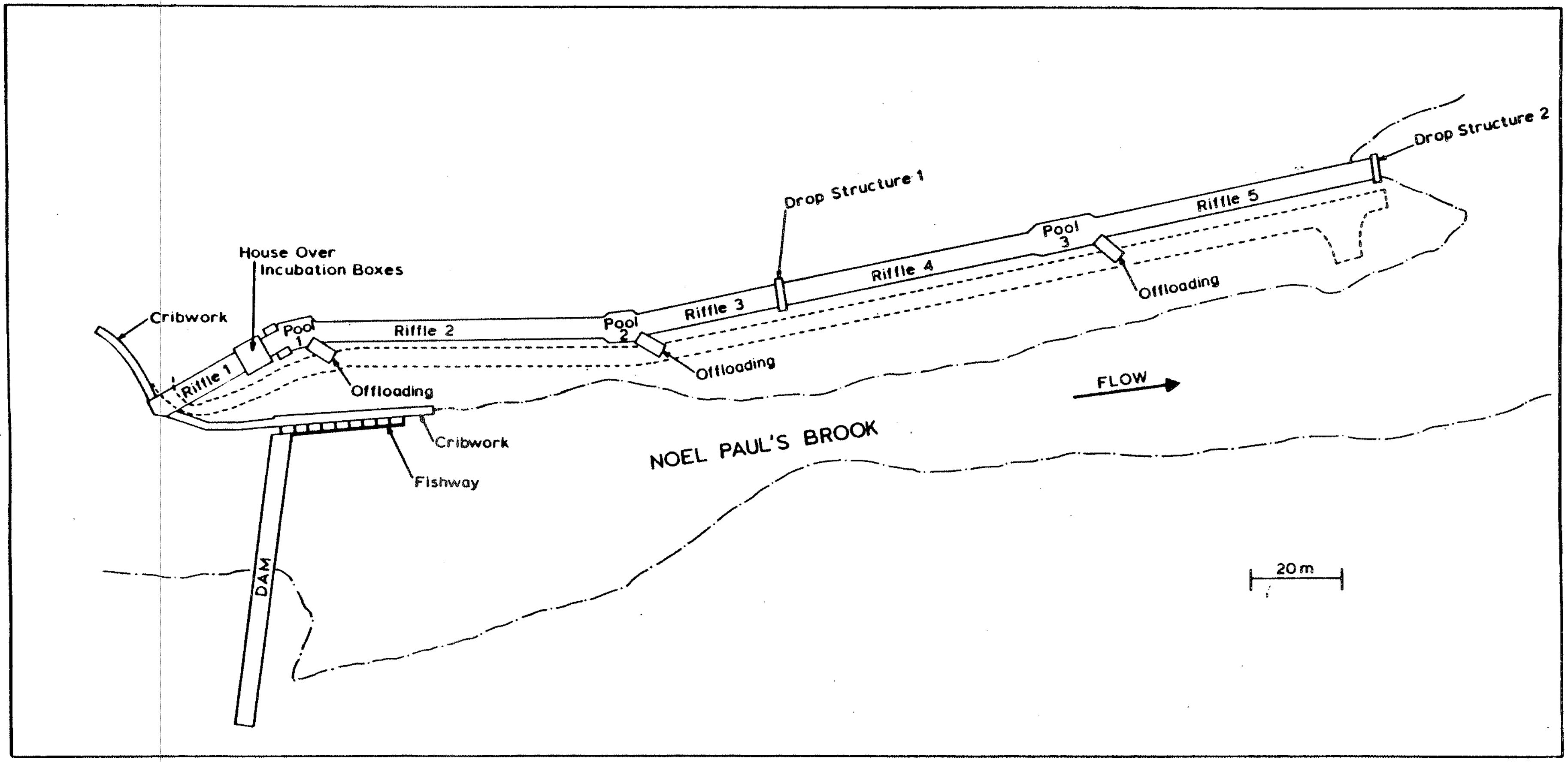


Fig. 3. A schematic diagram of the Noel Paul's Brook incubation facility (approximately to scale).

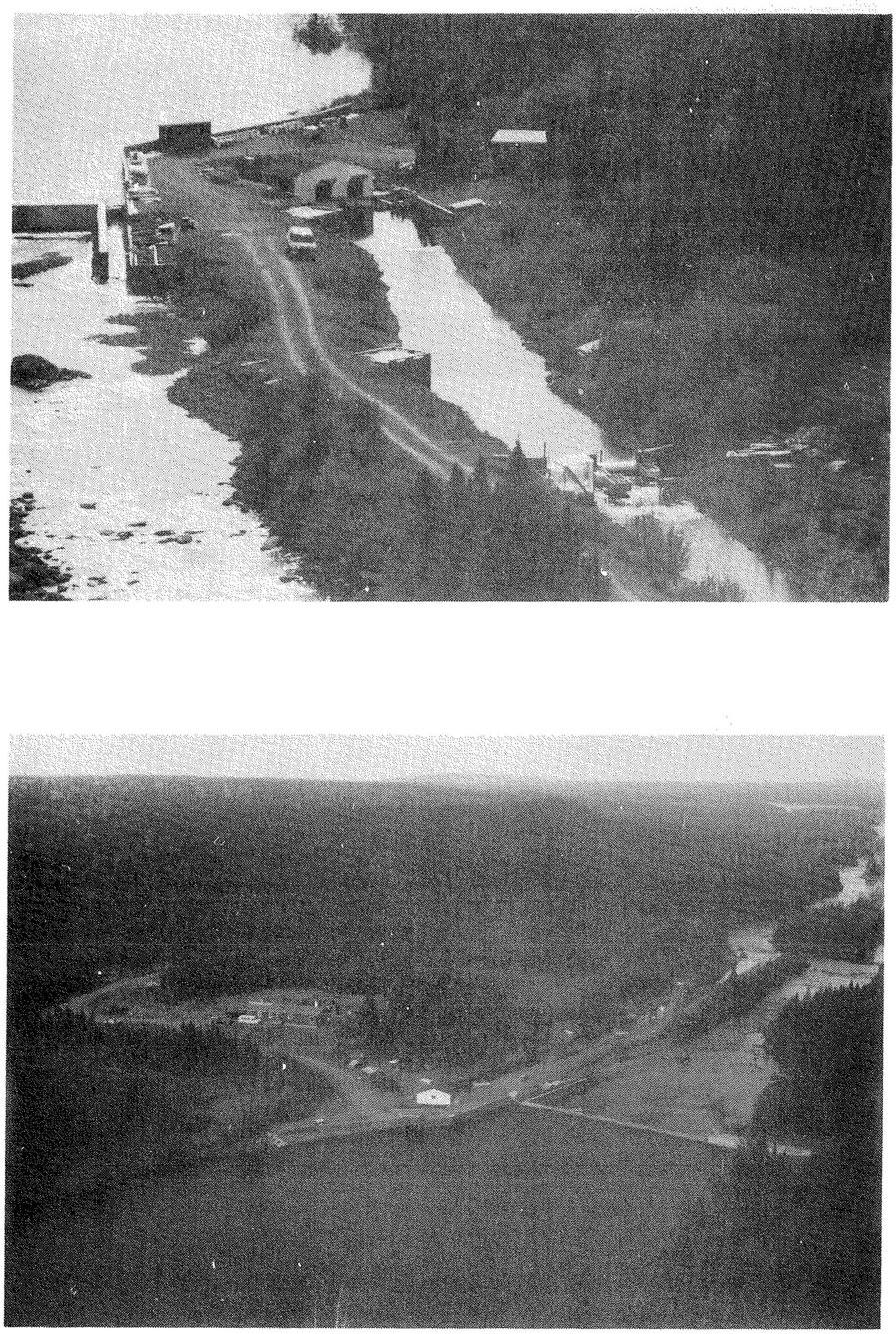
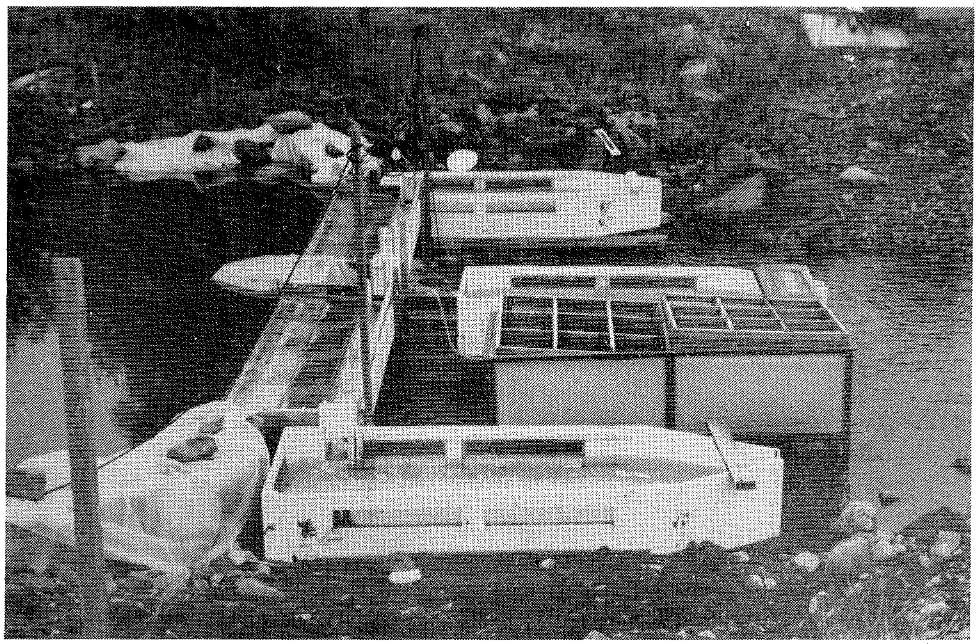


Fig. 4. Aerial views of the Noel Paul's Brook incubation facility.



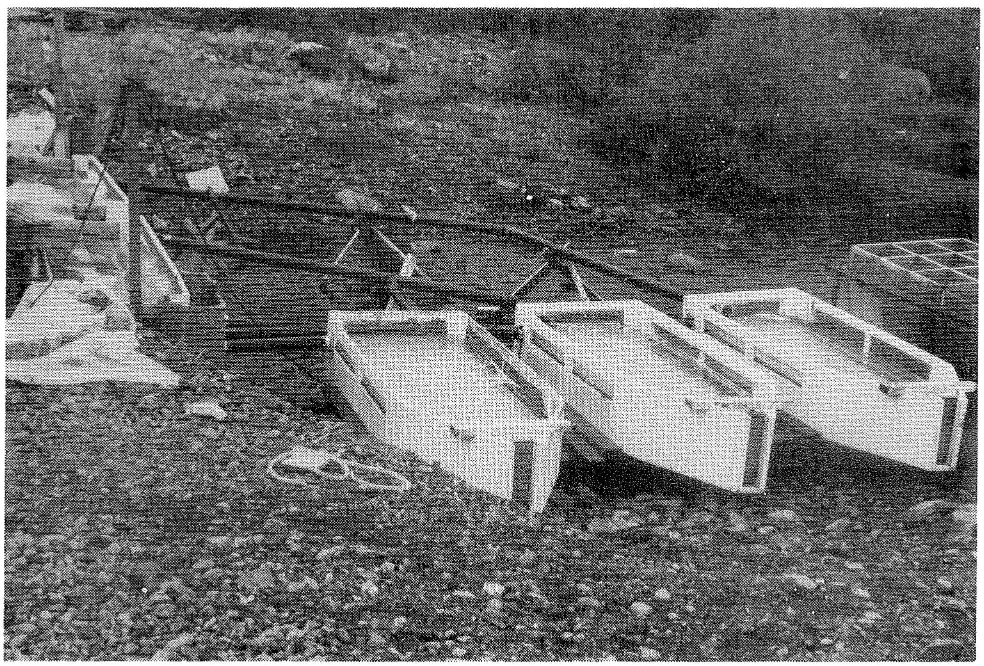


Fig. 5. Wolf trap installations at drop structure 1 (upper photo) and drop structure 2 (lower photo), Noel Paul's Brook spawning channel.

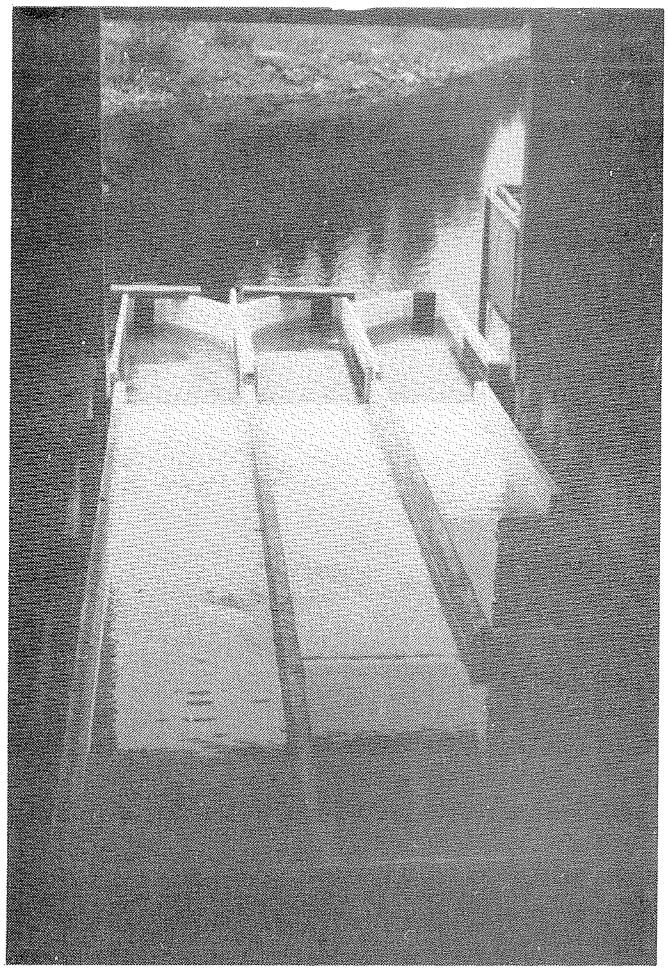
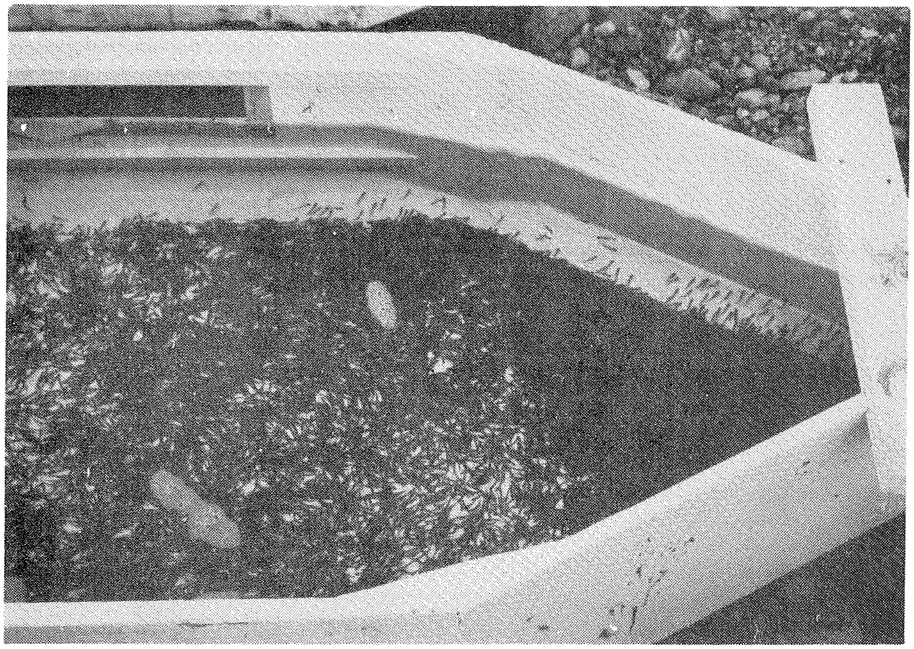


Fig. 6. Wolf trap installations for the incubation boxes viewed from inside (upper photo) and outside (lower photo) of the house, Noel Paul's Brook.



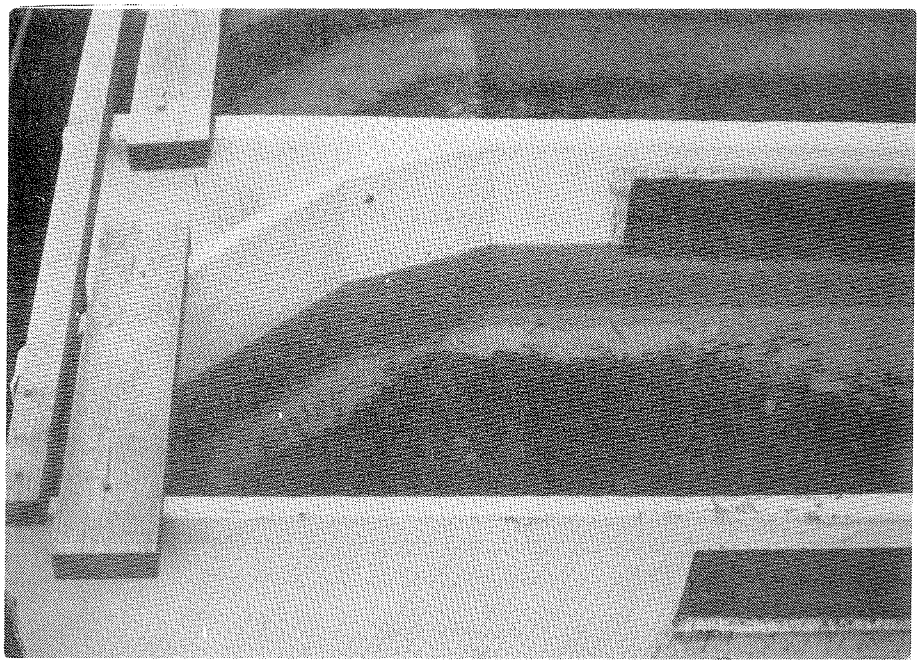


Fig. 7. Overnight emergence of fry for a spawning channel Wolf trap (upper photo) and an incubation box Wolf trap (lower photo) during peak emergence.

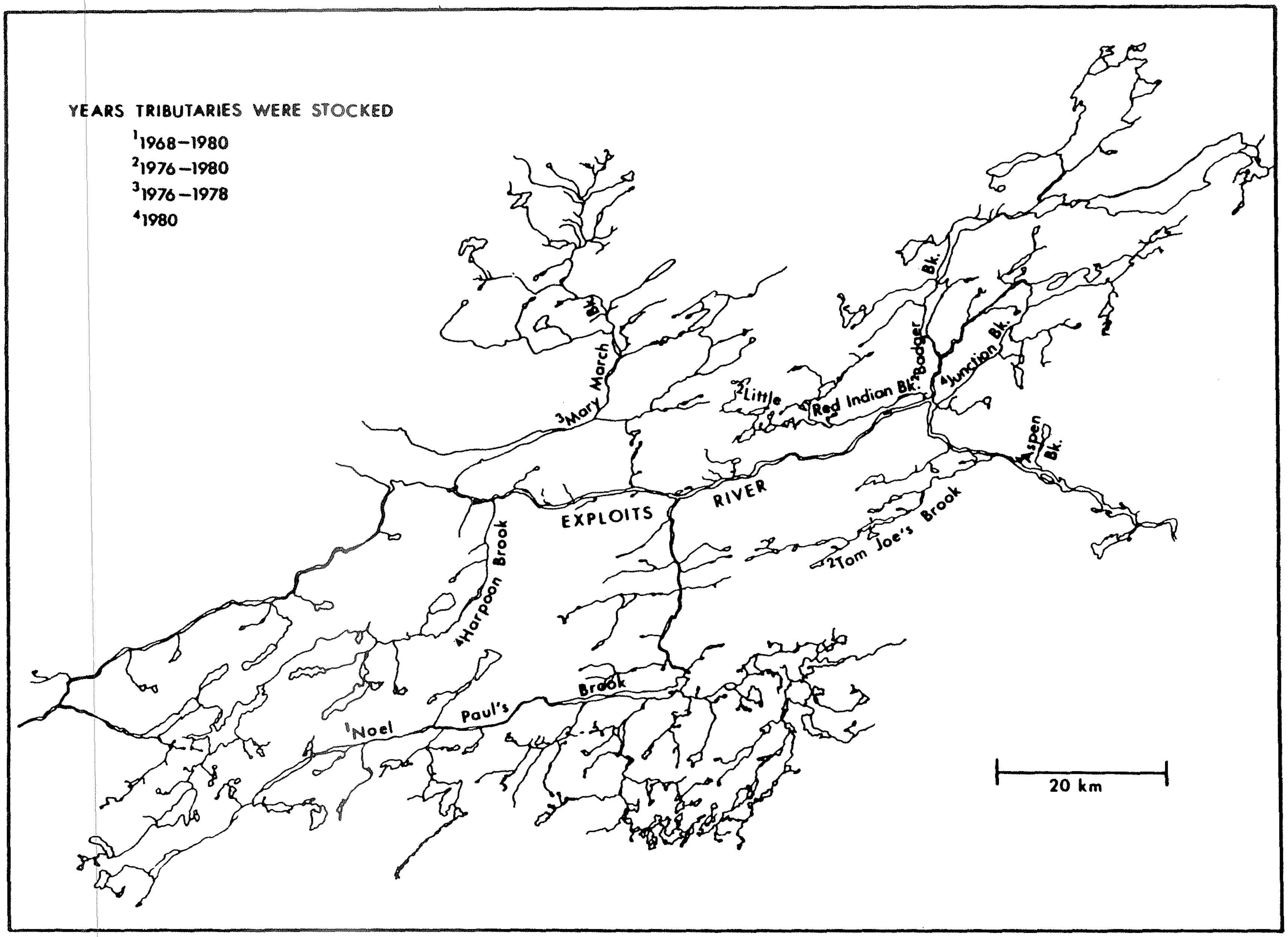
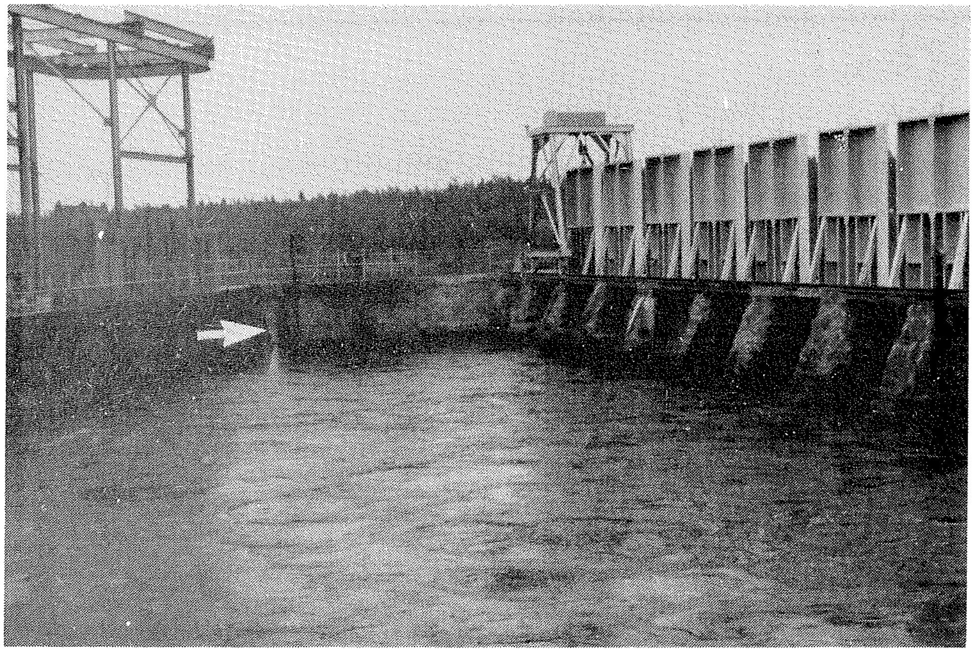


Fig. 8. Map of the middle Exploits showing the tributaries stocked and the years each was stocked.



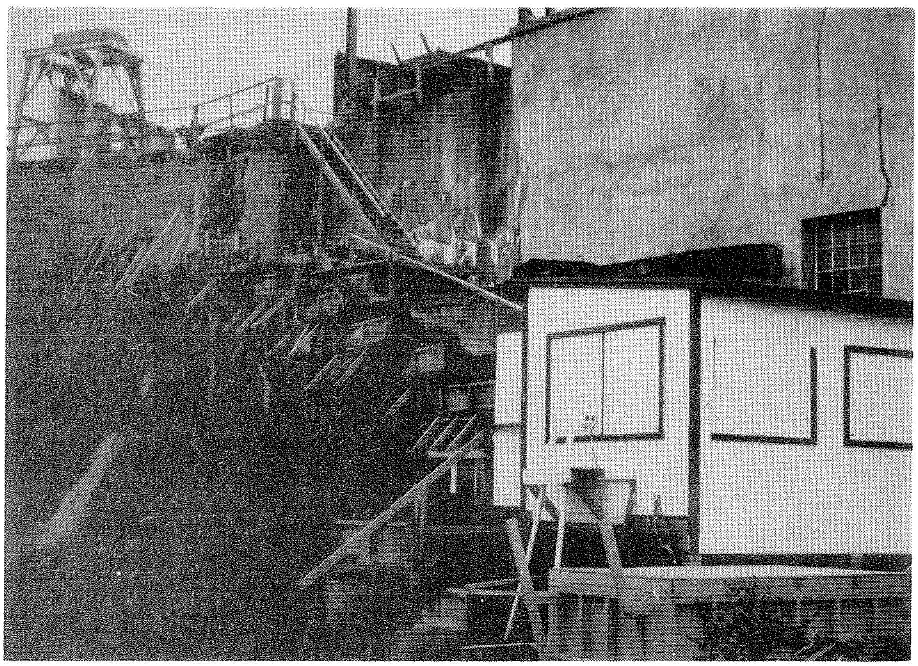


Fig. 9. A view of water conditions inside the Bishop's Falls forebay during operation of all turbines (upper photo) and the reverse fishway used to trap smolts and kelts (lower photo). Arrow points to the exit from the forebay into the reverse fishway.

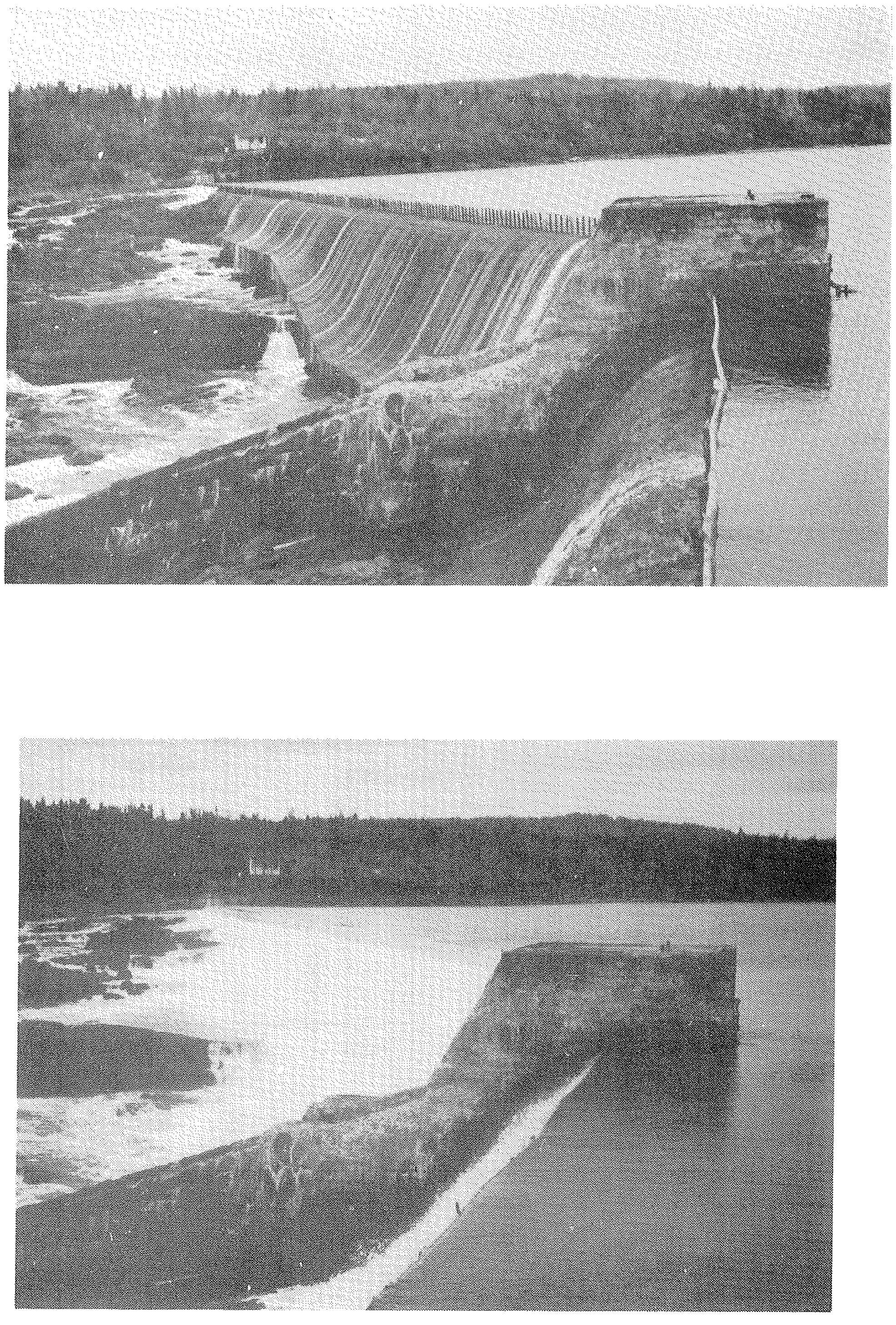


Fig. 10. Bishop's Falls dam showing the effect of flashboard installation on height of water in the head-pond.

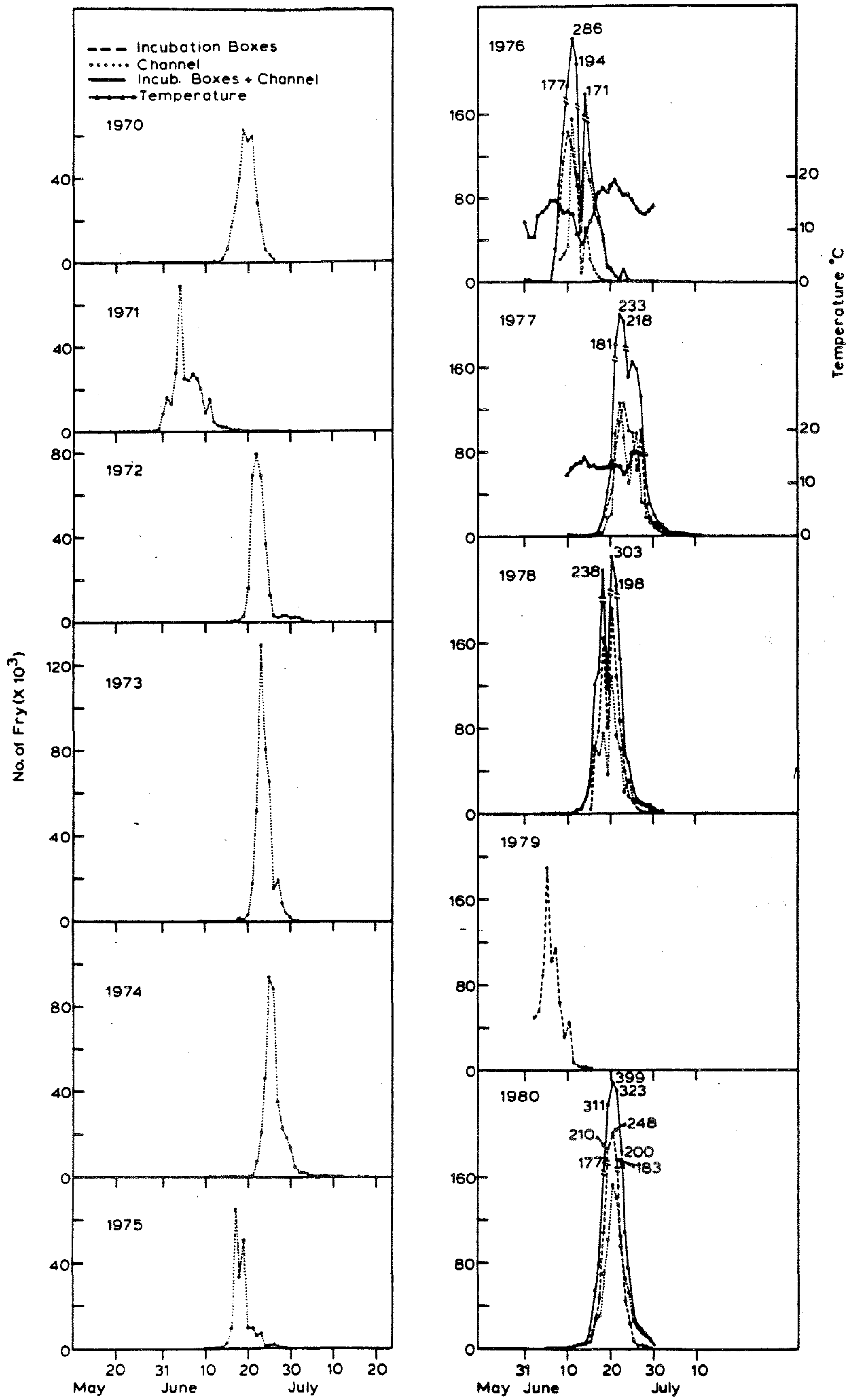


Fig. 11. Daily fry counts at the Noel Paul's Brook incubation facility, 1970-1980. Mean daily water temperature (°C) is included for 1976 and 1977.

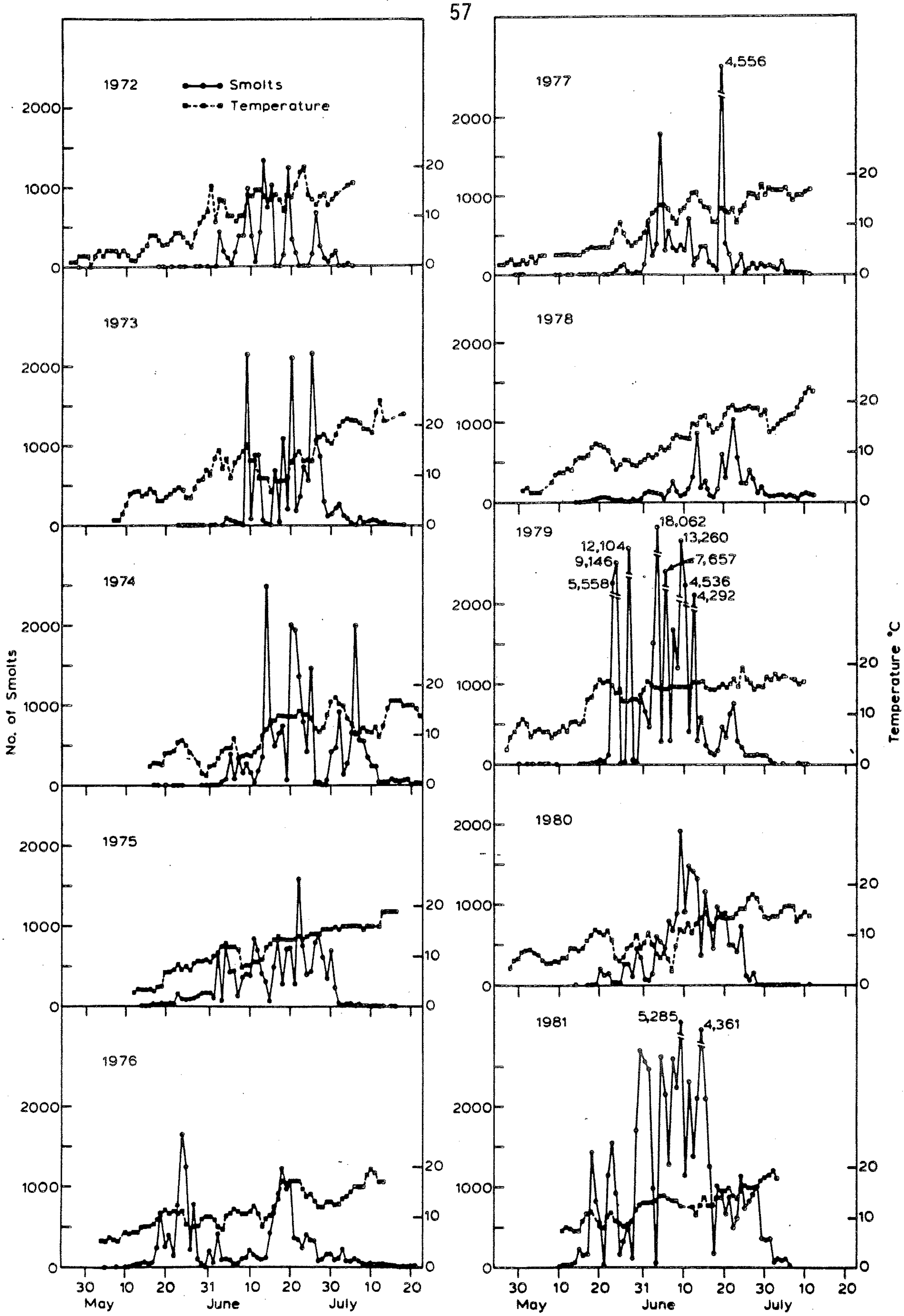


Fig. 12. Daily smolt counts at the Bishop's Falls forebay, 1972-1981. Mean daily water temperature (°C) included.

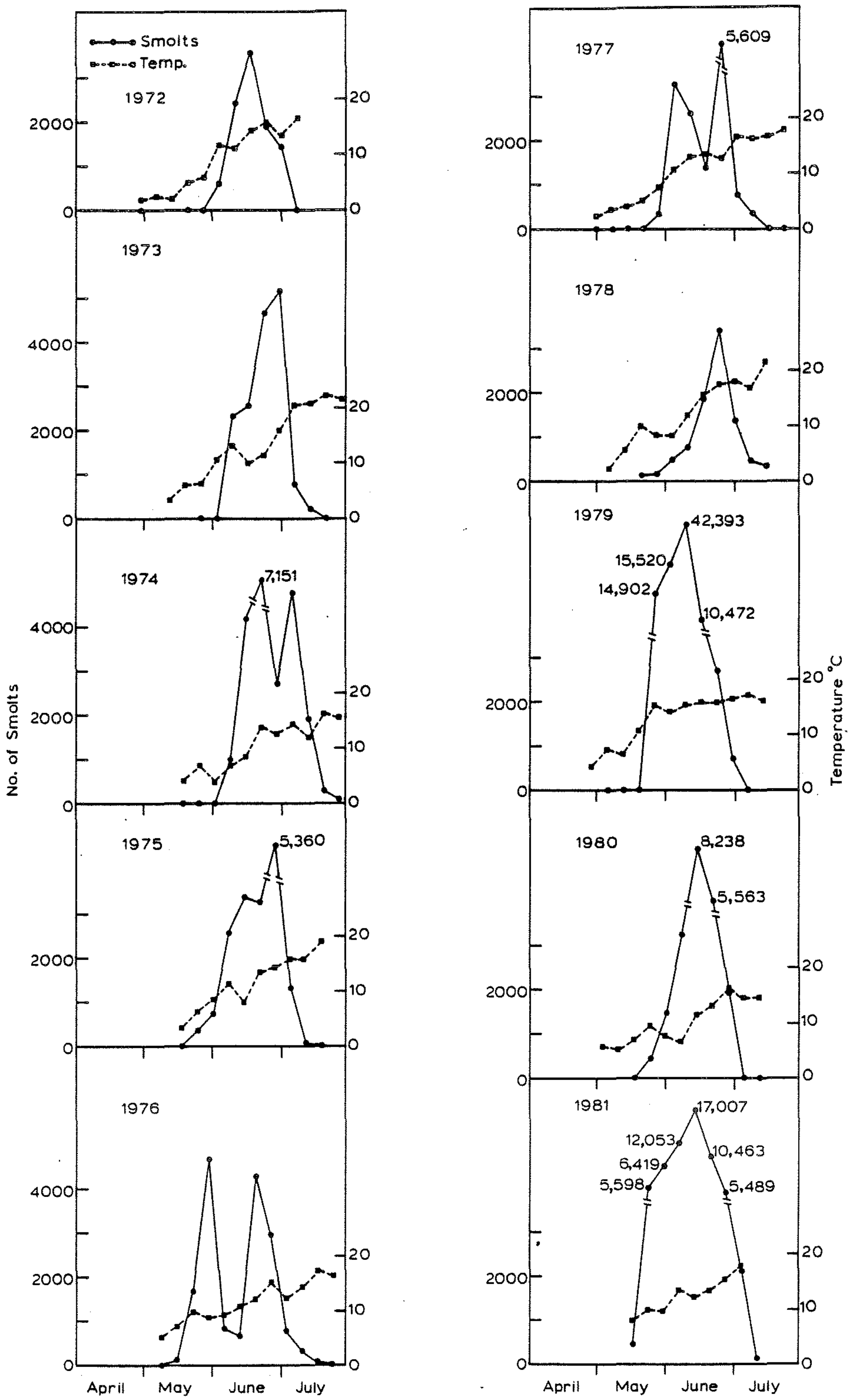


Fig. 13. Weekly smolt counts at the Bishop's Falls forebay, 1972-1981. Mean weekly water temperature (°C) included.

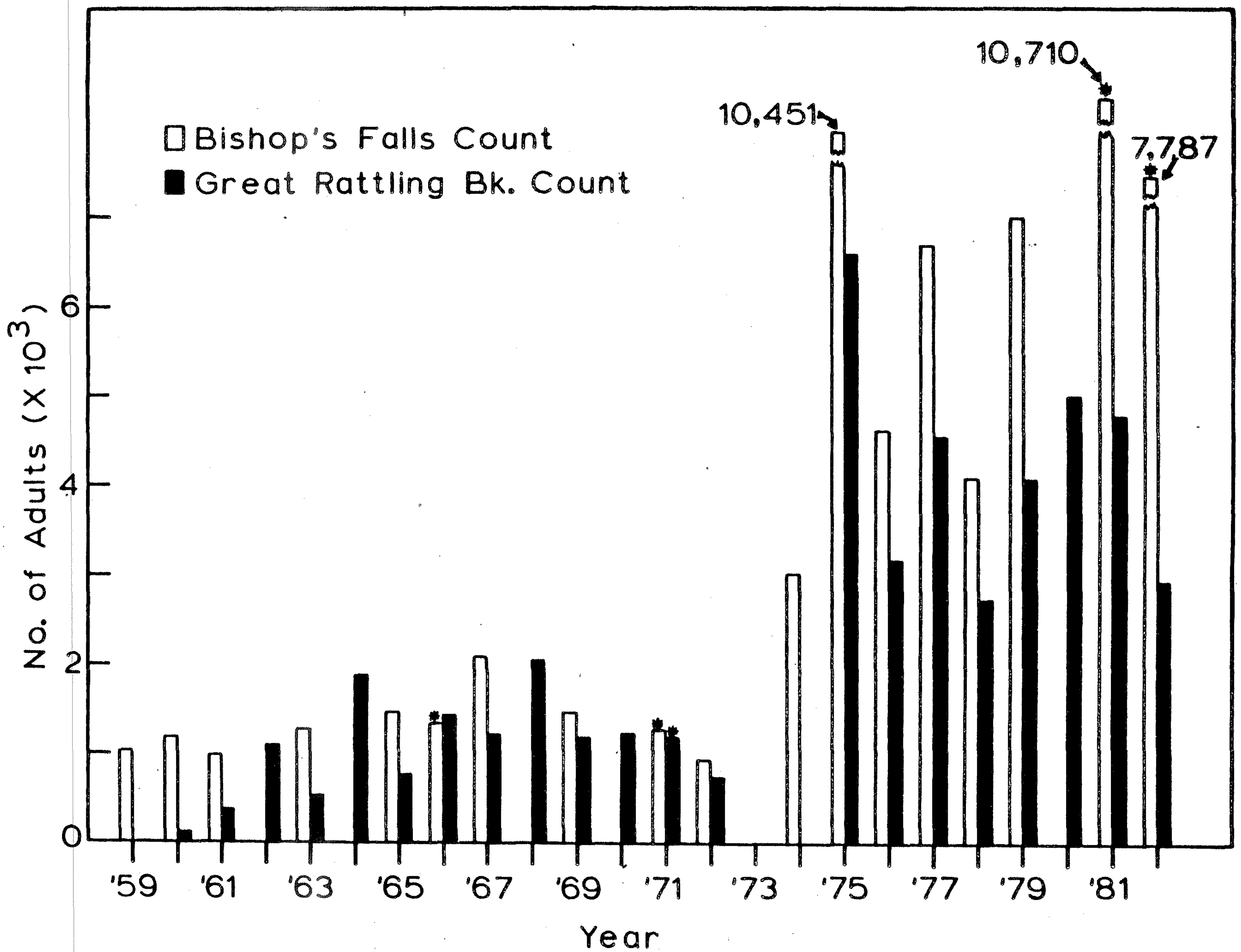


Fig. 14. Adult counts at the Bishop's Falls fishway and the Camp I fishway (Great Rattling Brook, 1959-1982. Asterisk above a histogram denotes a partial count.

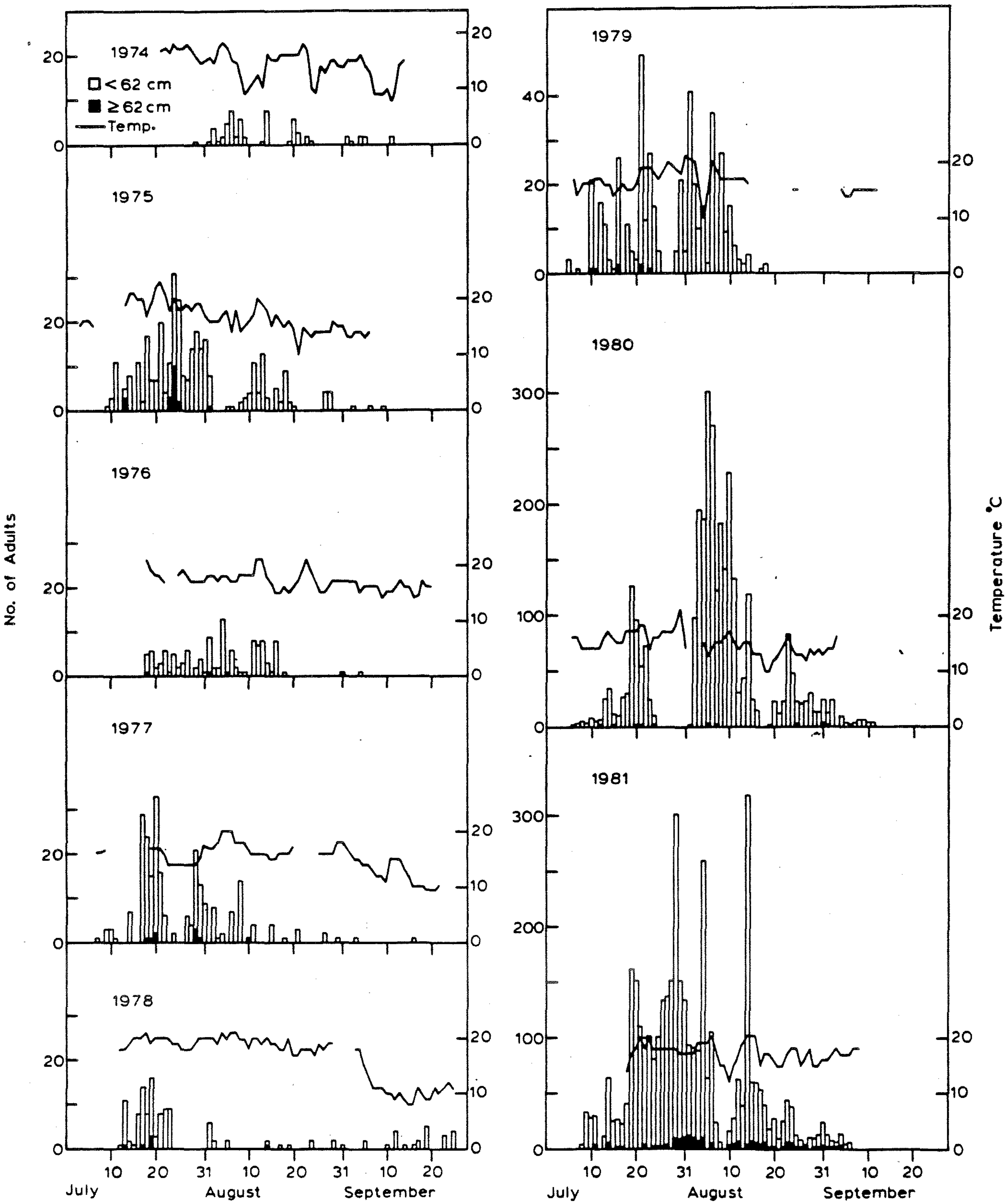


Fig. 15. Daily adult counts at the Grand Falls collection facility, 1974-1981. Mean daily water temperature (°C) included.

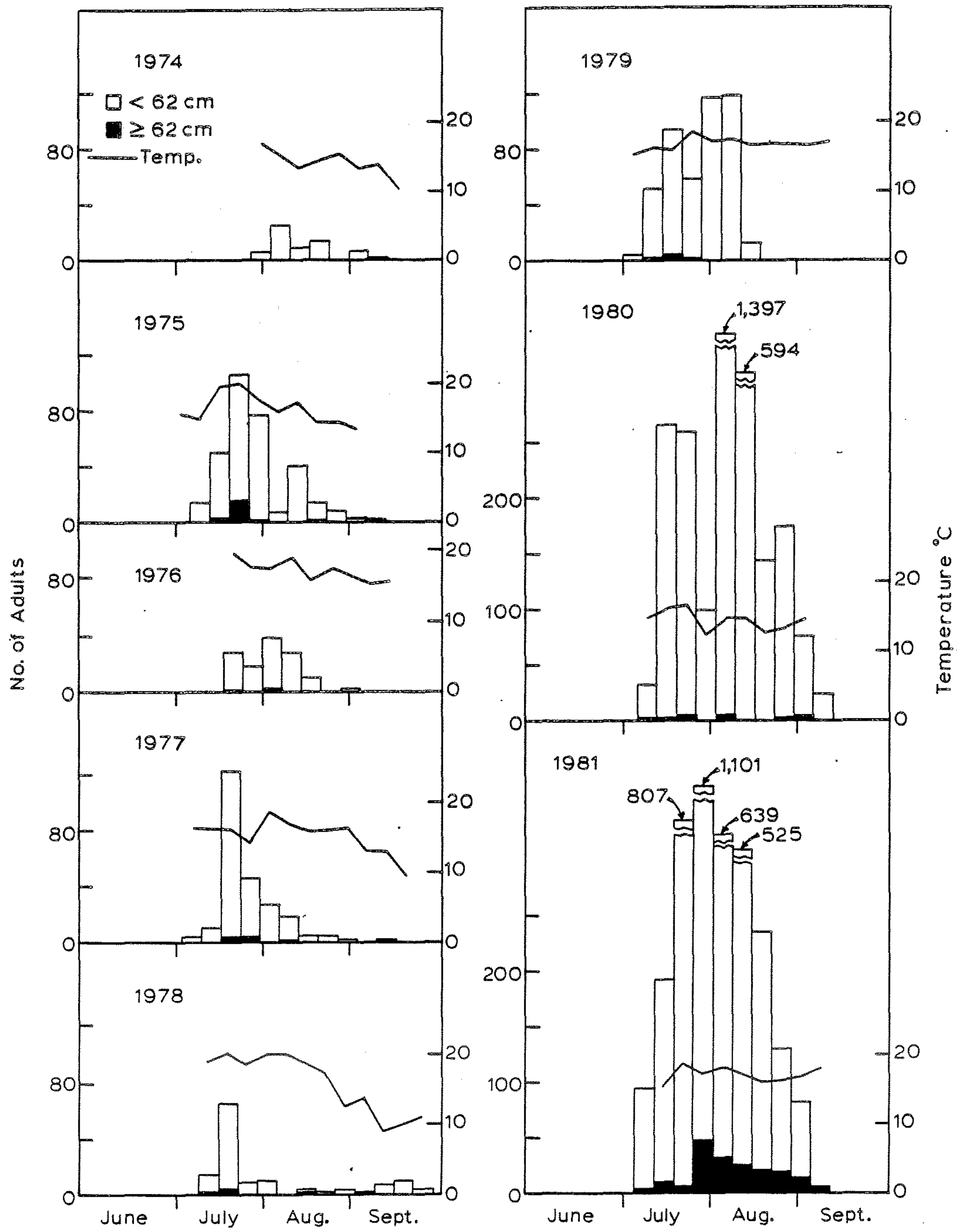


Fig. 16. Weekly adult counts at the Grand Falls collection facility, 1974-1981. Mean weekly water temperature (°C) included.

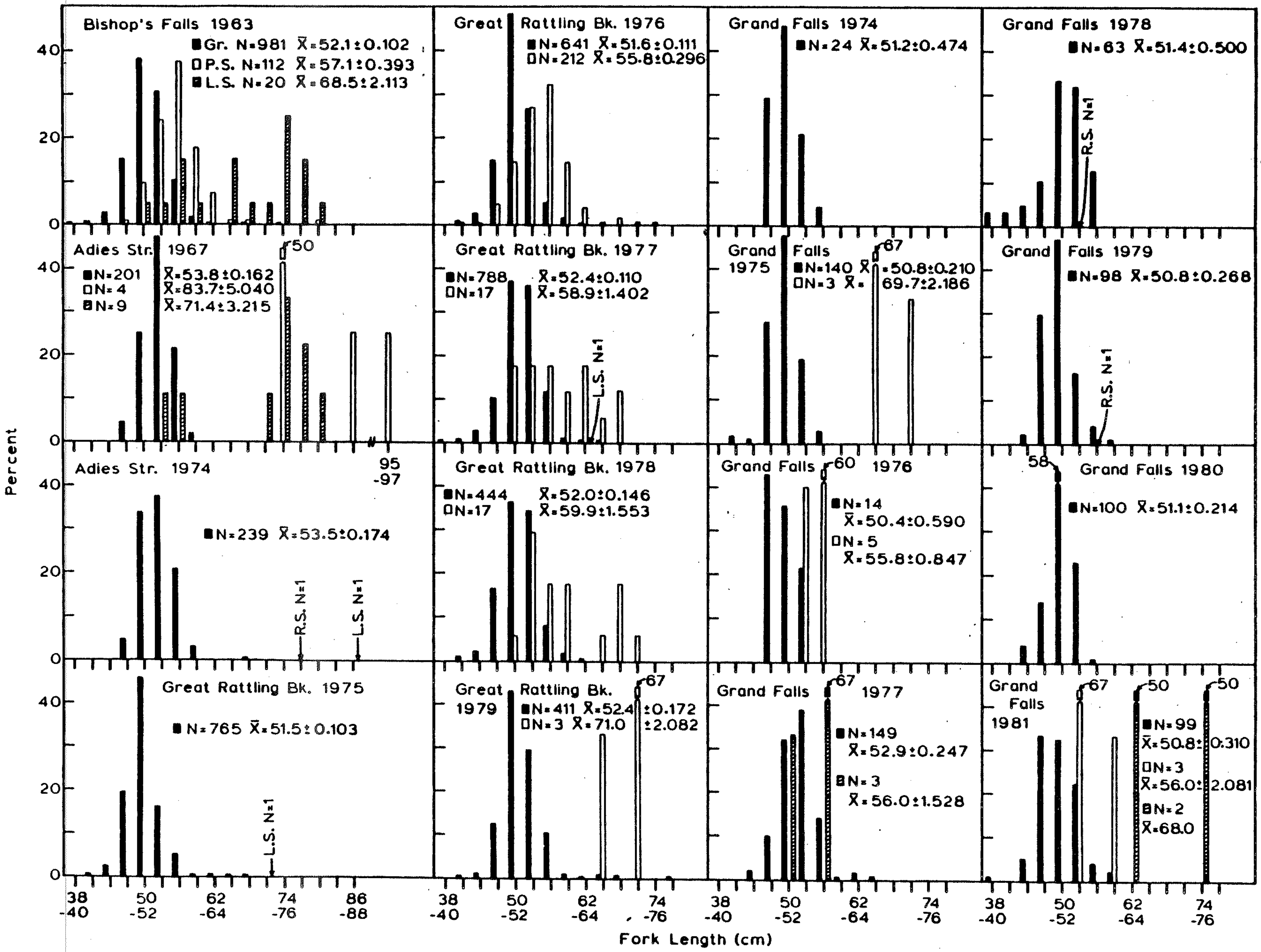


Fig. 17. Length frequency distributions for adults from the Bishop's Falls fishway, Adies Stream, the Camp I fishway (Great Rattling Brook) and the Grand Falls collection facility. Mean length ± S.E. is also shown. Gr. = grilse; P.S. = previous spawner; L.S. = large salmon.

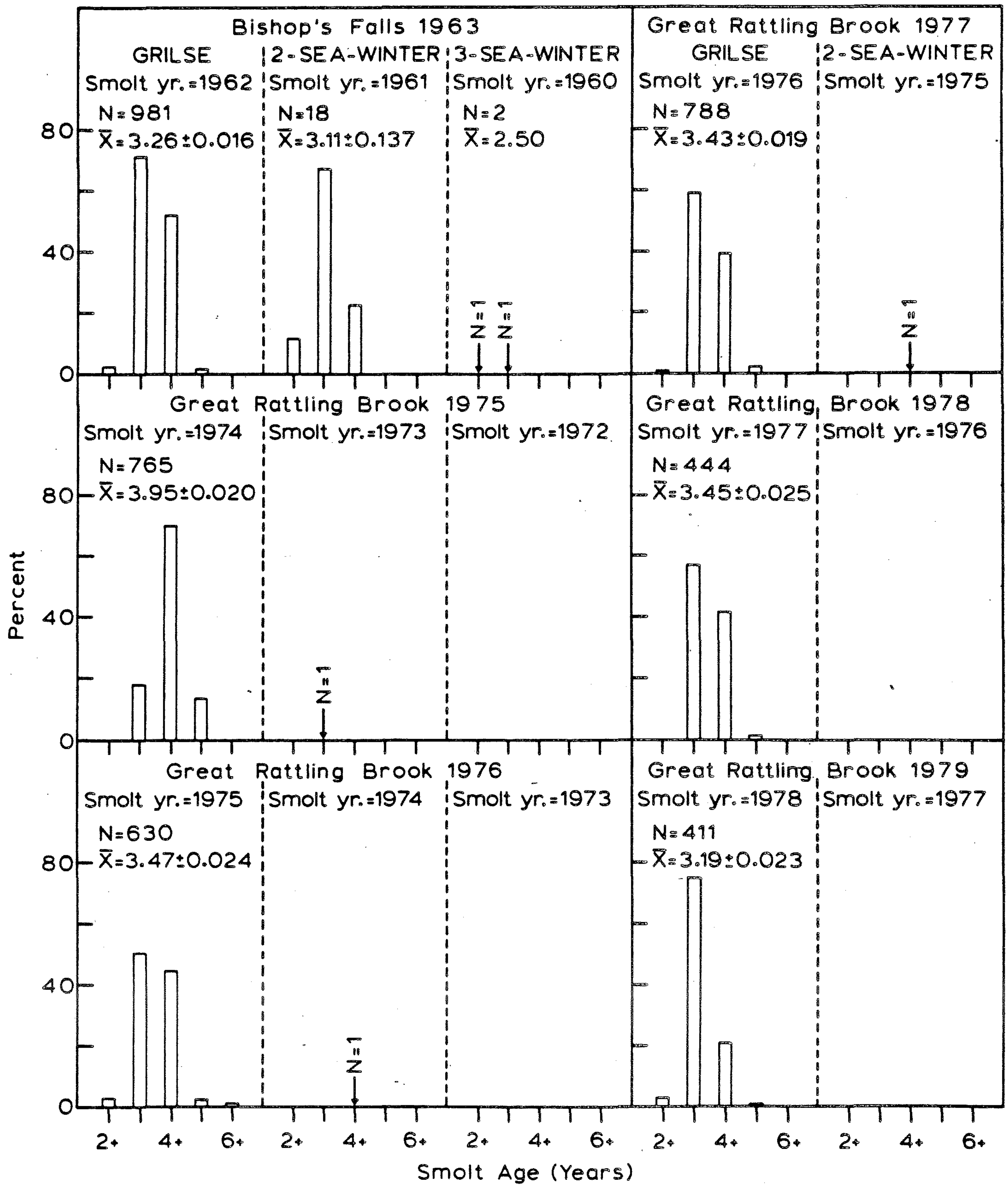


Fig. 18. Smolt age composition as determined from adult scales for samples taken from the Bishop's Falls fishway and the Camp I fishway (Great Rattling Brook). Mean age ± S.E. is also shown.

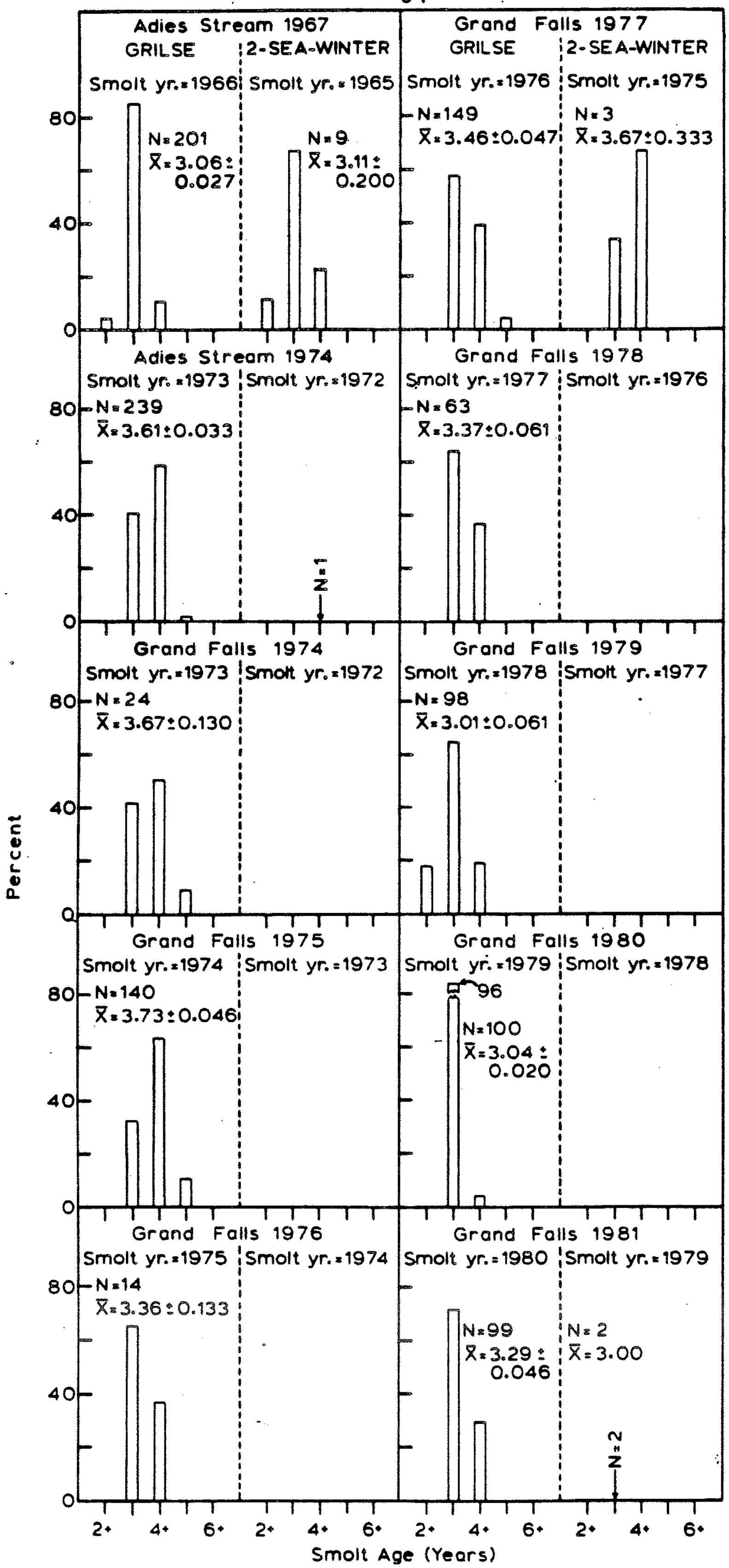


Fig. 19. Smolt age composition as determined from adult scales for samples taken from Adies Stream and the Grand Falls collection facility. Mean age ± S.E. is also shown.

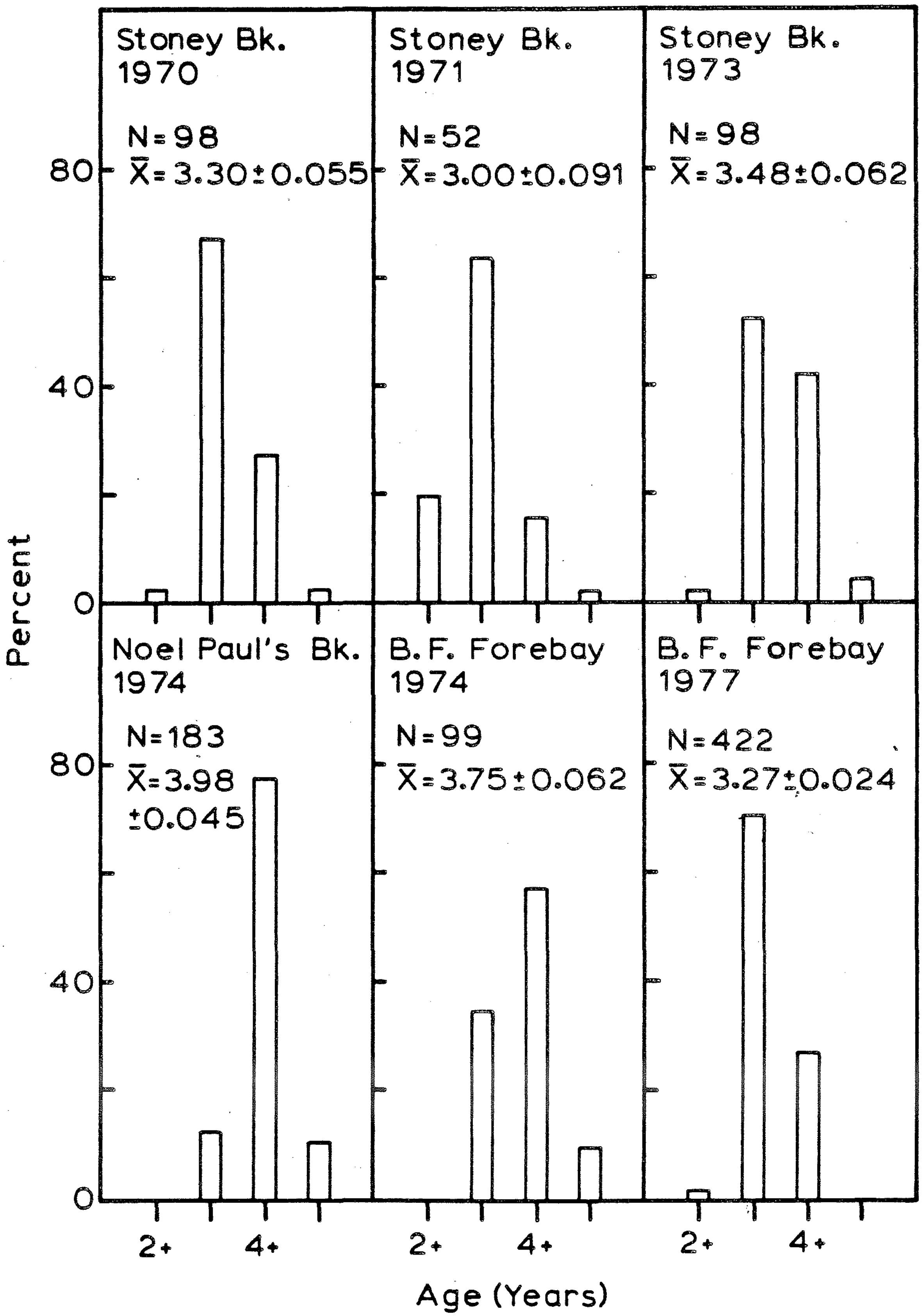


Fig. 20. Age composition of smolts from various points on the Exploits River. Mean age ± S.E. is also shown.

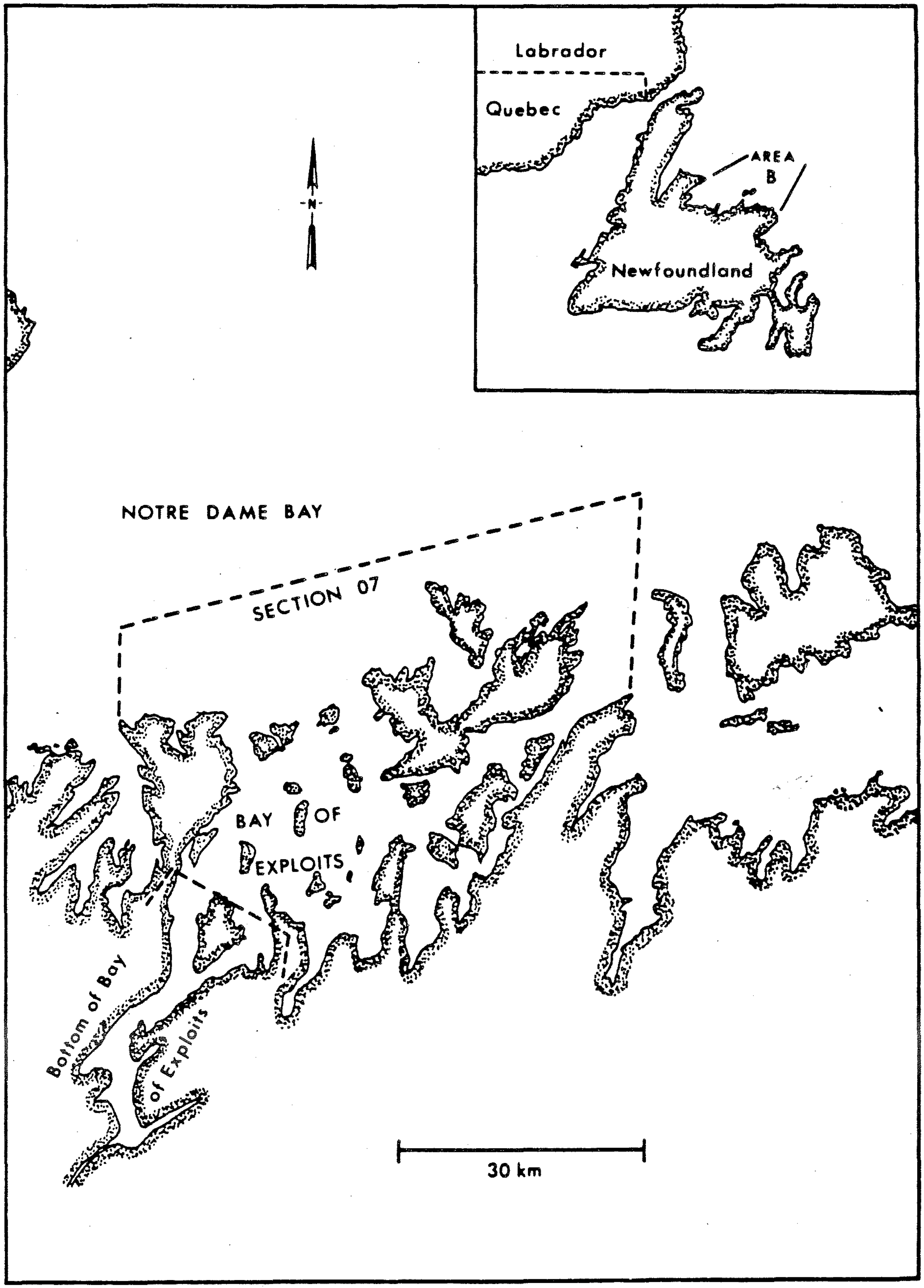


Fig. 21. Map showing sketched Area B, Section 07, Notre Dame Bay.

APPENDIX 1: EGG DEPOSITION, FRY EMERGENCE AND EGG TO FRY SURVIVAL FOR EACH SECTION OF THE SPAWNING CHANNEL AND EACH INCUBATION BOX

Year	Location	Egg Deposition (No.)	Fry Emergence (No.)	Survival %
1967/68	Riffles 2, 3, 4, and 5	289,450	152,838	52.8
1968/69	Riffles 2, 3, 4 and 5	296,822	162,409	54.7
1969/70	Riffles 2 and 3	200,900	138,558	69.0
	Riffles 4 and 5	270,000	189,170	70.1
1970/71	Riffles 2 and 3	144,935	75,415	52.0
	Riffles 4 and 5	331,996	227,354	68.5
1971/72	Riffles 2 and 3	155,500	56,485	36.3
	Riffles 4 and 5	472,000	255,386	54.1
1972/73	Riffle 1	26,692	12,388	46.4
	Riffles 2 and 3	250,204	189,893	75.9
	riffles 4 and 5	321,296	196,804	61.3
1973/74	Riffle 1	41,210	16,631	40.4
	Riffles 2 and 3	258,125	[a]109,941	42.6
	Riffles 4 and 5	244,038	[b]173,548	71.1
	[c]Upwelling Box (Diffuser)	11,443	4,060	35.5
	[d]Manual Planting (3 sets - 3 trenches)	70,250	[a]62,341	88.7
1974/75	Riffle 1	49,898	1,470	3.0
	Riffles 2 and 3	288,233	91,444	31.7
	Riffles 4 and 5	269,625	109,767	40.7
1975/76	Riffles 2 and 3	351,396	373,365	[e]106.3
	Riffles 4 and 5	453,278	436,532	[e]96.3
	Incubation Box No. 1	549,462	392,564	71.5
	Incubation Box No. 2	487,995	308,976	63.3
1976/77	Riffles 2 and 3	385,343	343,520	89.2
	Riffles 4 and 5	468,352	352,327	75.2
	Incubation Box No. 1	504,994	416,074	82.4
	Incubation Box No. 2	471,431	398,797	84.6

Appendix 1 (cont'd.).

Year	Location	Egg Deposition (No.)	Fry Emergence (No.)	Survival %
1977/78	Riffles 2 and 3	389,000	384,765	[e]98.9
	Riffles 4 and 5	477,000	243,763	51.1
	Incubation Box No. 1	497,000	407,398	81.8
	Incubation Box No. 2	533,000	434,136	81.5
1978/79	Incubation Box No. 1	552,000	384,845	69.7
	Incubation Box No. 2	559,000	363,597	65.0
1979/80	Riffles 2 and 3	407,000	399,026	[e]98.0
	Riffles 4 and 5	475,000	427,876	[e]90.1
	Incubation Box No. 1	645,000	511,349	79.3
	Incubation Box No. 2	630,000	510,622	81.1

[a]Figures are not representative since a number of fry escaped from the first drop structure (below riffles 2 and 3) into the manual planting area
[b]Includes 9,622 fry from efficiency fence below the second drop structure
[c]Experimental incubation box installed in diffuser (Mercer and Anderson 1974)
[d]Planted in Riffle 1, Riffles 2 and 3 and Riffles 4 and 5
[e]See Results Section

Note: Data for 1967-73 inclusive are from Pratt et al. (1974)

APPENDIX 2: DAILY FRY COUNTS FOR EACH DROP STRUCTURE OF THE SPAWNING CHANNEL, FOR EACH INCUBATION BOX, AND TOTAL CHANNEL OUTPUT FOR THE YEARS 1970-80

Appendix 2a. Daily fry counts for each drop structure of the spawning channel and total channel output, 1970.

Date	First Drop Structure	Second Drop Structure	Totals	Mortality (included in totals)
May 23	1	0	1	0
24	1	0	1	0
25	1	0	1	0
26	0	0	0	0
27	0	0	0	0
28	0	1	1	0
29	0	0	0	0
30	0	1	1	0
31	0	1	1	0
June 1	0	3	3	0
2	0	2	2	0
3	1	4	5	1
4	5	11	16	5
5	1	7	8	3
6	2	30	32	0
7	7	28	35	2
8	16	56	72	2
9	5	33	38	1
10	17	38	55	1
11	88	76	164	4
12	98	439	537	6
13	51	308	359	7
14	81	1,458	1,539	6
15	246	6,040	6,286	27
16	872	15,609	16,481	14
17	3,334	22,738	26,072	82
18	7,760	32,165	39,925	108
19	20,916	41,980	62,896	493
20	32,065	25,244	57,309	2,592
21	39,806	20,060	59,866	445
22	18,119	9,949	28,068	483
23	9,829	7,495	17,324	670
24	2,769	3,053	5,822	527
25	1,632	1,756	3,388	472
26	835	585	1,420	839
Totals	138,558	189,170	327,728	

Appendix 2b. Daily fry counts for each drop structure of the spawning channel and total channel output, 1971.

Date		First Drop Structure	Second Drop Structure	Totals	Mortality (included in totals)
May	14	8	1	9	0
	15	3	2	5	0
	16	0	0	0	0
	17	24	2	26	3
	18	0	0	0	0
	19	3	1	4	0
	20	3	4	7	0
	21	1	0	1	0
	22	3	1	4	0
	23	20	12	32	0
	24	2	0	2	0
	25	36	27	63	0
	26	12	54	66	0
	27	26	74	100	0
	28	15	34	49	0
	29	50	200	250	0
	30	77	542	619	84
	31	1,020	7,529	8,549	221
June	1	3,225	13,138	16,363	349
	2	3,281	9,983	13,264	115
	3	6,565	21,471	28,036	1,008
	4	17,136	52,100	69,236	554
	5	4,743	20,551	25,294	2,279
	6	5,728	18,512	24,240	127
	7	8,418	19,057	27,475	60
	8	7,430	17,886	25,316	351
	9	6,725	13,487	20,212	250
	10	3,040	6,154	9,194	19
	11	3,343	11,450	14,793	113
	12	1,267	3,775	5,042	10
	13	705	2,686	3,391	17
	14	643	2,162	2,805	28
	15	624	1,996	2,620	5
	16	525	792	1,317	13
	17	138	991	1,129	398
	18	200	806	1,006	60
	19	130	600	730	0
	20	100	500	600	0
	21	50	151	201	4
	22	51	385	436	5

Appendix 2b. (cont'd)

Date	First Drop Structure	Second Drop Structure	Totals	Mortality (included in totals)
June 23	20	104	124	10
24	7	69	76	29
25	4	22	26	6
26	10	27	37	7
27	4	11	15	0
28	0	0	0	0
29	0	0	0	0
30	0	5	5	0
Totals	75,415	227,354	302,769	6,125

Appendix 2c. Daily fry counts for each drop structure of the spawning channel and total channel output, 1972.

Date	First Drop Structure	Second Drop Structure	Totals	Mortality (included in totals)
June 15	15	60	75	0
16	17	93	110	0
17	51	299	350	0
18	14	568	582	9
19	133	2,421	2,554	6
20	2,737	13,375	16,112	76
21	11,916	57,480	69,396	150
22	15,800	63,790	79,590	1,340
23	12,714	56,372	69,086	105
24	7,680	29,173	36,853	325
25	2,263	10,825	13,088	38
26	919	2,752	3,671	15
27	300	2,260	2,560	10
28	250	3,230	3,480	30
29	450	3,163	3,613	13
30	260	2,233	2,493	43
July 1	500	2,210	2,710	10
2	200	1,905	2,105	11
3	125	1,510	1,635	15
4	78	907	985	10
5	63	760	823	10
Totals	56,485	255,386	311,871	2,216

Appendix 2d. Daily fry counts for each drop structure of the spawning channel and total channel output, 1973.

Date	Temporary Trap (Riffle #1)	First Drop Structure	Second Drop Structure	Efficiency Fence	Totals	Mortality (included in totals)
June 9	0	0	40	0	40	6
10	0	0	29	0	29	1
11	0	0	1	0	1	0
12	0	0	42	0	42	0
13	0	7	18	0	25	0
14	0	9	24	0	33	0
15	1	3	29	0	33	0
16	0	5	35	0	40	5
17	0	4	89	0	93	1
18	3	4	1,536	0	1,543	3
19	1	6	540	9	556	8
20	45	89	2,239	34	2,407	34
21	728	2,361	13,988	32	17,109	125
22	1,282	24,401	25,690	240	51,613	513
23	3,679	65,090	59,360	1,543	129,672	15,000
24	2,150	40,300	38,000	-	80,450	-
25	2,725	32,400	30,300	-	65,425	-
26	930	11,160	3,564	-	15,654	-
27	648	7,686	10,818	-	19,152	200
28	176	3,292	4,810	-	8,278	10
29	20	1,623	2,421	-	4,064	-
30	0	1,226	911	-	2,137	12
July 1	0	120	58	-	178	3
2	0	70	120	-	190	-
12	Electrofishing	37	184	-	221	-
Totals	12,388	189,893	194,946	1,858	398,985	15,920

Appendix 2e. Daily fry counts for each drop structure of the spawning channel, for various experimental plantings (Mercer and Anderson 1974) and total channel output, 1974.

Date	Upwelling Box (Diffuser)	Temporary Trap (Riffle #1)	First Drop Structure	Manual Planting (Trenches) Temporary Traps 1	2	3	Second Drop Structure	Efficiency Fence	Totals	Mortality (included in totals)
June 11	24	0	0	2	0	0	0	0	26	0
12	7	0	0	0	0	0	0	0	7	0
13	0	0	0	0	0	0	0	0	0	0
14	19	0	0	0	0	0	0	0	19	0
15	55	0	0	0	0	0	0	0	55	0
16	311	0	0	0	0	0	0	0	311	0
17	60	0	0	0	0	0	0	0	60	0
18	31	0	18	0	0	0	0	0	49	0
19	38	0	29	0	0	0	0	0	67	0
20	33	1	189	24	0	0	24	0	271	13
21	37	0	370	135	0	0	87	0	629	7
22	52	0	2,092	1,564	234	0	2,045	127	6,114	46
23	288	428	8,176	4,917	852	3	5,829	860	21,353	496
24	566	1,770	12,153	12,798	1,252	103	17,920	0	46,562	182
25	1,114	2,460	30,471	11,177	3,008	337	40,935	4,105	93,607	234
26	590	4,256	31,871	1,865	6,118	384	41,883	1,892	88,859	771
27	132	1,802	10,027	1,016	640	224	20,302	1,153	35,296	86
28	230	2,790	5,370	1,458	3,138	150	9,492	530	23,158	243
29	351	1,650	4,152	1,434	560	223	11,001	502	19,872	325
30	50	898	3,043	814	1,157	146	7,364	246	13,718	178
July 1	34	422	1,085	642	435	68	2,587	48	5,321	45
2	23	82	167	260	540	56	1,645	0	2,773	35
3	6	27	65	1,437	518	26	360	0	2,439	375
4	5	20	143	510	152	236	816	75	1,957	178
5	1	7	26	252	273	227	331	0	1,117	66
6	2	8	22	190	91	27	139	11	490	21
7	0	7	32	51	97	14	124	5	330	54
8	0	3	82	14	144	41	200	16	500	97
9	0	-	53	69	31	1	59	18	231	45
10	0	-	44	43	17	-	102	21	227	54

Appendix 2e. (cont'd)

Date	Upwelling Box (Diffuser)	Temporary Trap (Riffle #1)	First Drop Structure	Manual Planting (Trenches) Temporary traps 1	2	3	Second Drop Structure	Efficiency Fence	Totals	Mortality (included in totals)
July 11	1	-	29	36	35	-	122	14	237	47
12	-	-	31	60	15	-	109	-	215	26
13	-	-	0	-	-	-	0	-	0	0
14	-	-	0	-	-	-	0	-	0	0
15	-	-	0	-	-	-	0	-	0	0
16	-	-	140	-	-	-	330	-	470	30
17	-	-	0	-	-	-	0	-	0	0
18	-	-	61	-	-	-	120	-	181	16
18	Electrofishing								577	
Totals	4,060	16,631	109,941	40,768	19,307	2,266	163,926	9,622	367,098	3,670

Appendix 2f. Daily fry counts for each drop structure of the spawning channel and total channel output, 1975.

Date	Temporary Trap (Riffle #1)	First Drop Structure	Second Drop Structure	Efficiency Fence	Totals	Mortality (included in totals)
June 10	2	27	1	4	34	0
11	3	79	2	0	84	0
12	2	57	3	0	62	0
13	0	65	12	0	77	0
14	0	420	3	0	423	0
15	26	2,540	260	0	2,826	10
16	42	4,794	4,628	0	9,464	40
17	300	27,840	36,610	120	64,870	163
18	500	14,087	19,298	60	33,945	88
19	235	23,690	26,573	19	50,517	94
20	280	4,397	5,190	1	9,868	17
21	0	5,130	4,579	1	9,710	12
22	1	2,587	3,467	2	6,057	34
23	25	3,174	4,081	-	7,280	16
24	15	501	752	-	1,268	3
25	37	504	1,265	-	1,806	11
26	2	507	1,505	-	2,014	12
27	-	450	750	-	1,200	-
28	-	200	350	-	550	-
29	-	70	100	-	170	-
29	Electrofishing	325	338	-	663	-
Total	1,470	91,444	109,767	207	202,888	500

Appendix 2g. Daily fry counts for each drop structure of the spawning channel, for each incubation box and total facility output, 1976. Water temperature included.

Date	Incubation Box No. 1	Incubation Box No. 2	First Drop Structure	Second Drop Structure	Efficiency Fence	Totals	Mortality (included in totals)	Temperature (°C) Max.	Temperature (°C) Min.
May 31	1,180	1,071	0	0	0	2,251	0	13.0	9.4
June 1	1,700	836	0	0	0	2,636	100	9.2	7.8
2	100	300	0	0	0	400	0	10.1	7.1
3	100	0	0	0	0	100	0	13.9	11.0
4	210	100	0	0	0	310	4	15.1	11.5
5	582	191	0	0	0	773	2	15.3	12.7
6	711	264	0	0	0	975	3	17.6	13.4
7	19,416	13,960	0	0	0	33,376	96	16.6	14.3
8	29,668	42,020	6,241	14,942	20	92,891	137	15.6	13.9
9	43,287	72,158	8,145	17,902	100	141,592	1,581	14.8	11.1
10	89,033	54,561	12,915	21,909	200	178,618	4,682	14.7	11.9
11	84,707	44,763	58,286	96,783	1,800	286,339	393	13.9	11.6
12	59,157	32,230	27,527	74,836	600	194,350	197	11.6	6.6
13	3,050	6,355	20,584	28,128	150	58,267	261	8.0	6.4
14	31,261	24,995	56,711	57,434	350	170,751	136	12.9	6.7
15	16,726	6,030	53,772	43,750	1,200	121,478	580	12.8	10.4
16	7,985	3,601	38,650	27,281	300	77,817	71	16.4	12.0
17	1,770	3,023	35,185	21,070	200	61,248	90	19.4	14.0
18	1,008	1,512	24,687	13,921	3,184	44,312	55	19.7	15.8
19	470	339	7,563	6,267	510	15,149	103	19.2	14.8
20	230	274	5,418	5,015	148	11,085	146	20.5	16.1
21	109	245	2,420	1,748	4	4,526	44	20.8	17.8
22	71	60	1,350	990	12	2,483	6	18.4	16.6
23	35	58	11,250	750	1	12,094	22	17.8	14.7
24	8	30	630	450	10	1,128	34	17.0	15.8
25	0	0	327	230	-	557	13	16.2	15.2
26	0	0	213	166	-	379	38	15.1	12.9

Appendix 2g. (cont'd)

Date	Incubation Box No. 1	Incubation Box No. 2	First Drop Structure	Second Drop Structure	Efficiency Fence	Totals	Mortality (included in totals)	Temperature (°C) Max.	Min.
June 27	0	0	85	88	-	173	11	13.4	13.0
28	0	0	75	64	-	139	7	13.4	12.8
29	0	0	72	46	-	118	6	14.2	13.0
30	0	0	0	80	-	80	4	14.7	14.1
July 1	0	0	0	20	-	20	1	-	-
2	0	0	0	2	-	2	0	-	-
8	Electrofishing	-	1,259	2,660	-	3,919	169	-	-
Total	392,574	308,976	373,365	436,532	8,789	1,520,236	8,992	-	-

Appendix 2h. Daily fry counts for each drop structure of the spawning channel, for each incubation box and total facility output, 1977. Water temperature included.

Date	Incubation Box No. 1	Incubation Box No. 2	First Drop Structure	Second Drop Structure	Efficiency Fence	Totals	Mortality (included in totals)	Temperature (°C) Max.	Temperature (°C) Min.
June 10	439	432	0	0	0	871	0	13.5	9.9
11	350	200	0	0	0	550	0	15.5	9.9
12	10	11	0	0	0	21	0	14.5	12.8
13	105	50	0	0	0	155	5	15.2	12.6
14	336	134	16	1	0	487	3	16.1	13.4
15	241	339	76	1	0	657	5	13.6	12.3
16	692	282	175	11	0	1,160	7	13.9	12.5
17	1,165	502	280	573	0	2,520	25	13.3	12.1
18	10,016	4,366	500	514	130	15,526	146	14.9	10.5
19	16,410	7,574	2,001	14,716	100	40,801	42	14.4	11.4
20	29,002	13,488	6,630	13,854	405	63,379	439	16.4	11.4
21	51,911	32,034	21,272	75,565	417	181,199	584	14.6	11.6
22	67,040	40,505	42,790	82,748	7	233,090	849	13.4	12.8
23	61,894	63,434	42,473	49,875	354	218,030	195	12.8	10.0
24	51,618	48,206	28,514	21,144	208	149,690	329	15.9	10.1
25	46,416	51,209	40,604	25,519	426	164,174	183	17.8	13.2
26	24,260	37,498	67,726	28,577	202	158,263	212	17.0	14.3
27	36,065	64,157	21,525	10,013	3	131,763	98	16.5	14.0
28	8,391	9,452	21,099	7,307	-	46,249	39	16.2	14.2
29	4,194	13,704	10,246	2,475	-	30,619	25	-	-
30	2,735	5,032	10,126	2,558	-	20,451	51	-	-
July 1	1,744	3,164	5,908	2,164	-	12,980	111	-	-
2	635	1,669	5,903	1,961	-	10,168	41	-	-
3	256	861	3,155	1,111	-	5,383	25	-	-
4	100	130	1,892	828	-	2,950	11	-	-
5	49	116	1,164	831	-	2,160	19	-	-

Appendix 2h. (cont'd)

Date	Incubation Box No. 1	Incubation Box No. 2	First Drop Structure	Second Drop Structure	Efficiency Fence	Totals	Mortality (included in totals)	Temperature (°C) Max.	Min.
July 6	0	0	1,900	1,651	-	3,551	1	-	-
7	0	31	901	400	-	1,332	1	-	-
8	0	17	870	380	-	1,267	0	-	-
9	0	200	949	290	-	1,439	69	-	-
10	0	0	940	370	-	1,310	0	-	-
11	0	0	454	209	-	663	0	-	-
	Electrofishing		3,431	4,429		7,860	18	-	-
Totals	416,074	398,797	343,520	350,075	2,252	1,510,718	3,533	-	-

Appendix 2i. Daily fry counts for each drop structure of the spawning channel, for each incubation box and total facility output, 1978.

Date	Incubation Box No. 1	Incubation Box No. 2	First Drop Structure	Second Drop Structure	Totals	Mortality (included in totals)
June 2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	30	30	0
5	0	0	0	0	0	0
6	0	0	0	20	20	0
7	0	0	0	15	15	0
8	0	0	0	26	26	0
9	0	0	12	50	62	0
10	0	0	17	210	227	0
11	0	0	24	10	34	0
12	0	0	510	2,100	2,610	0
13	0	0	430	2,470	2,900	0
14	0	0	867	11,245	12,112	55
15	500	2,750	5,628	20,729	29,607	1,790
16	40,360	19,048	10,320	49,624	119,352	1,169
17	44,199	31,639	15,970	38,254	130,062	294
18	77,111	86,312	41,342	33,422	238,187	865
19	44,396	35,261	20,339	15,118	115,114	1,452
20	82,211	93,653	95,786	31,435	303,085	3,069
21	53,129	74,084	61,463	9,688	198,364	1,092
22	37,794	47,835	47,310	11,701	144,640	702
23	15,213	24,225	16,952	2,156	58,546	127
24	5,814	9,520	26,758	3,943	46,035	466
25	3,990	5,732	11,271	1,566	22,559	10
26	1,314	2,037	8,611	1,460	13,422	54
27	200	1,067	6,297	790	8,354	70
28	100	500	5,320	1,030	6,950	0
29	35	260	4,014	3,035	7,344	47
30	32	213	1,820	940	3,005	65
July 1	0	0	340	352	665	35
2	0	0	820	610	1,430	10
	Electrofishing		2,544	1,761	4,305	301
Totals	406,398	434,136	384,765	243,763	1,469,062	11,673

Appendix 2j. Daily fry counts for each incubation box and total facility output, 1979.

Date	Incubation Box No. 1	Incubation Box No. 2	Totals	Mortality (included in totals)
June 2	30,440	17,730	48,170	455
3	28,679	27,146	55,825	645
4	44,872	43,181	88,053	941
5	98,333	90,041	188,374	1,971
6	52,951	52,684	105,635	1,173
7	46,876	65,283	112,159	1,077
8	28,695	33,659	62,354	1,047
9	17,138	12,922	30,060	467
10	28,241	16,659	44,900	350
11	3,769	2,475	6,244	190
12	2,106	921	3,027	57
13	1,068	457	1,525	55
14	1,237	439	1,676	41
15	440		440	0
Totals	384,845	363,597	748,442	8,469

Appendix 2k. Daily fry counts for each drop structure of the spawning channel, for each incubation box and total facility output, 1980.

Date	Incubation Box No. 1	Incubation Box No. 2	First Drop Structure	Second Drop Structure	Totals	Mortality (included in totals)
June 5	0	0	0	10	10	0
6	0	0	8	12	20	0
7	0	0	20	29	49	6
8	0	0	151	8	159	0
9	0	0	85	65	150	21
10	0	0	636	150	786	36
11	0	0	930	55	985	35
12	0	0	2,110	706	2,816	16
13	0	0	3,010	950	3,960	10
14	0	0	3,300	1,200	4,500	0
15	4,930	6,745	3,151	3,617	18,443	43
16	11,298	16,206	10,770	14,285	52,559	158
17	18,136	28,424	11,090	18,975	76,625	127
18	46,486	61,308	26,122	43,236	177,152	910
19	112,602	97,790	34,542	66,358	311,292	8,261
20	136,292	112,106	59,655	91,866	399,919	5,072
21	91,523	91,894	61,829	77,814	323,060	6,724
22	48,643	56,284	50,820	43,932	199,679	1,645
23	22,192	20,972	40,803	23,527	107,494	286
24	11,349	11,175	35,092	16,450	74,066	154
25	3,524	4,013	15,915	9,682	33,134	34
26	1,465	1,825	13,049	6,100	22,439	39
27	2,180	1,100	9,832	4,193	17,305	95
28	522	550	8,741	2,582	12,395	51
29	207	230	5,245	1,574	7,256	30
30	0	0	2,120	500	2,620	0
Totals	511,349	510,622	399,026	427,876	1,848,873	23,753

APPENDIX 3: DAILY SMOLT AND KELT ENUMERATIONS AT THE BISHOP'S FALLS FOREBAY FOR THE YEARS 1972-81

Appendix 3a. Daily smolt and kelt enumerations at the Bishop's Falls forebay, 1972. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	*Water Temperature	*Water Height
April	25	-	1	-	-
	26	-	-	1.1	1.1
	27	-	-	1.1	1.1
	28	1	1	2.2	1.1
	29	-	-	2.2	1.1
	30	-	-	2.2	1.1
May	1	-	1	0.0	1.1
	2	-	-	2.2	0.9
	3	-	-	3.3	0.8
	4	-	-	2.2	0.9
	5	-	2	3.3	0.9
	6	-	4	3.3	1.1
	7	-	-	3.3	1.2
	8	-	-	2.2	1.2
	9	-	-	3.3	1.2
	10	-	-	2.2	1.1
	11	-	-	1.1	1.1
	12	-	-	1.1	0.9
	13	-	-	2.2	0.7
	14	-	-	3.3	0.7
	15	-	3	4.4	0.7
	16	-	11	6.1	0.8
	17	-	3	6.1	1.1
	18	1	2	5.5	1.2
	19	2	1	4.4	1.4
	20	-	1	4.6	0.8
	21	1	11	5.5	0.8
	22	-	1	6.7	0.7
	23	2	6	7.0	0.8
	24	1	1	6.0	0.8
	25	-	-	4.8	0.6
	26	-	-	4.0	0.6
	27	4	-	6.7	0.7
	28	6	5	8.9	0.4
	29	-	-	10.0	0.4
	30	3	1	11.0	0.6
	31	-	-	16.0	0.7
June	1	2	8	8.9	0.8
	2	420	57	13.3	1.1
	3	187	28	13.3	1.1
	4	105	13	10.0	0.9

Appendix 3a (cont'd.)

Date		Smolts	Kelts	*Water Temperature	Water Height
June	5	26	1	10.0	1.2
	6	175	1	9.0	1.1
	7	377	6	10.0	1.0
	8	387	3	10.0	1.1
	9	973	3	14.4	0.8
	10	378	1	13.9	0.8
	11	40	2	15.6	0.6
	12	424	-	15.6	0.7
	13	1,325	4	13.9	0.8
	14	737	2	13.3	0.8
	15	1,020	5	13.3	0.8
	16	-	-	14.4	0.6
	17	-	-	13.3	0.6
	18	127	-	11.1	0.6
	19	1,239	7	14.4	0.8
	20	329	-	13.9	0.8
	21	153	1	16.1	0.8
	22	5	1	18.9	0.4
	23	7	-	20.0	0.4
	24	18	1	14.4	0.4
	25	129	-	13.3	0.5
	26	644	3	12.2	0.9
	27	233	-	13.9	1.0
	28	91	1	14.4	1.0
	29	45	-	12.2	1.1
	30	123	1	13.3	1.1
July	1	177	5	14.4	0.9
	2	-	-	-	-
	3	-	-	-	-
	4	15	1	16.1	0.4
	5	7	-	16.7	0.4
	6	-	-	-	-
	7	-	-	-	-
	8	-	-	-	-
	9	-	-	-	-
	10	-	-	-	-
	11	-	-	-	-
	12	-	-	-	-
	13	-	-	-	-

Appendix 3a (cont'd.)

Date	Smolts	Kelts	*Water Temperature	Water Height
14	-	-	-	-
15	-	-	-	-
Total	9,939	210	-	-

*Readings taken between 8:00 a.m. and 9:00 a.m.

Appendix 3b. Daily smolt and kelt enumerations at the Bishop's Falls forebay, 1973. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
May	7	-	1	1.1	1.1	1.3	1.3
	8	-	-	1.1	1.1	1.5	1.2
	9	-	-	2.2	2.2	1.4	1.4
	10	-	-	4.4	3.9	1.2	1.1
	11	-	-	7.2	5.6	1.3	1.2
	12	-	-	6.7	6.7	1.3	1.3
	13	-	-	7.2	6.7	1.3	1.3
	14	-	-	6.7	5.0	1.3	1.3
	15	-	1	6.7	5.6	1.1	0.8
	16	-	3	7.8	6.7	1.0	0.8
	17	-	5	6.7	6.7	1.0	1.0
	18	-	3	5.6	4.4	1.0	0.8
	19	-	3	5.6	4.4	0.8	0.8
	20	-	-	6.1	5.0	0.8	0.8
	21	-	-	6.7	5.6	0.4	0.4
	22	-	3	7.8	6.1	0.5	0.4
	23	5	4	9.4	6.1	0.4	0.3
	24	4	1	7.8	6.7	0.3	0.3
	25	1	2	6.7	4.4	0.3	0.3
	26	3	2	6.1	5.0	0.4	0.3
	27	1	4	7.8	6.7	0.3	0.3
	28	5	1	10.0	7.8	0.3	0.2
	29	2	12	11.7	6.7	0.2	0.1
	30	-	5	12.2	10.0	0.2	0.2
	31	1	1	10.0	10.0	0.2	0.2
June	1	1	-	13.3	13.3	0.4	0.4
	2	-	-	15.6	14.4	0.4	0.4
	3	-	9	12.2	10.0	0.4	0.3
	4	80	7	13.3	13.3	2.7	0.3
	5	54	2	13.3	5.6	0.3	0.2
	6	35	3	14.4	11.1	0.2	0.2
	7	22	7	13.9	13.3	0.2	0.2
	8	-	-	15.6	14.4	0.2	0.2
	9	2,135	4	17.8	14.4	0.3	0.2
	10	85	3	14.4	11.1	0.2	0.2
	11	873	4	15.6	10.0	0.3	0.2
	12	875	9	10.0	8.9	0.4	0.3
	13	48	16	10.0	8.9	0.2	0.2
	14	3	-	10.0	8.9	0.3	0.3
	15	3	1	7.8	5.6	0.1	0.3
	16	677	8	9.4	8.9	1.3	1.3

Appendix 3b (cont'd.)

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
June	17	20	1	10.0	7.8	1.0	1.0
	18	1,092	1	8.9	6.7	1.1	1.0
	19	206	7	11.1	7.8	1.4	1.3
	20	2,095	10	15.0	10.0	1.3	1.2
	21	160	1	15.0	12.8	1.1	1.0
	22	345	7	15.6	13.9	1.1	1.1
	23	723	7	14.4	11.1	1.3	1.2
	24	573	10	15.0	11.1	1.4	1.3
	25	2,154	3	14.4	11.1	1.3	1.3
	26	1,040	2	17.8	15.6	1.2	1.2
	27	843	1	18.9	16.7	1.1	1.1
	28	295	4	18.9	17.2	1.1	1.1
	29	111	-	17.8	16.1	1.4	1.2
	30	130	1	17.2	15.6	1.4	1.3
July	1	210	-	18.9	17.2	1.3	1.3
	2	258	-	22.2	17.8	1.3	1.2
	3	116	-	22.2	20.0	1.2	1.1
	4	78	1	22.2	20.6	1.2	1.1
	5	12	-	21.1	20.0	1.1	1.1
	6	7	-	21.1	21.1	1.1	1.1
	7	83	-	21.1	20.0	1.2	1.1
	8	20	-	20.0	18.3	1.1	1.1
	9	39	-	19.4	18.9	1.1	1.1
	10	55	-	18.9	18.3	1.1	1.0
	11	57	-	23.3	22.2	1.0	1.0
	12	21	-	25.6	24.4	1.0	1.0
	13	23	-	22.2	20.0	1.1	1.0
	18	7	-	22.2	22.2	1.0	1.0
	24	12	-	22.2	21.1	1.0	1.0
Total		15,698	180	-	-	-	-

Appendix 3c. Daily smolt and kelt enumerations at the Bishop's Falls Forebay, 1974. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
May	16	-	4	3.9	3.9	1.41	1.41
	17	1	3	4.5	4.5	1.31	1.28
	18	1	4	5.0	3.9	1.28	1.21
	19	0	1	4.5	3.9	1.15	1.09
	20	1	5	7.2	5.6	1.12	1.02
	21	0	11	6.7	6.1	0.99	0.89
	22	1	4	7.2	6.7	0.89	0.85
	23	1	27	8.9	8.4	0.82	0.62
	24	1	13	9.5	8.4	0.56	0.46
	25	0	3	8.4	7.2	0.49	0.46
	26	0	0	6.7	6.7	0.49	0.49
	27	FISHWAY CLOSED					
	28	0	8	4.5	4.5	0.49	0.49
	29	6	7	2.8	2.2	0.52	0.46
	30	3	21	2.2	1.7	0.62	0.59
	31	5	39	4.5	2.8	0.82	0.69
June	1	4	67	4.5	3.9	0.89	0.85
	2	5	80	6.7	4.5	0.95	0.92
	3	35	49	7.2	6.7	1.05	1.02
	4	60	7	10.0	5.6	1.02	0.99
	5	375	32	10.0	5.6	1.21	1.18
	6	64	19	10.0	8.9	1.18	1.15
	7	315	36	5.6	5.6	1.18	1.15
	8	140	12	6.1	5.6	1.15	1.09
	9	260	10	6.1	6.1	1.05	1.02
	10	154	25	6.1	5.6	1.05	0.95
	11	11	5	6.7	6.1	0.92	0.82
	12	184	11	8.9	5.6	0.92	0.75
	13	335	21	11.1	8.9	0.82	0.75
	14	2,489	47	12.2	10.6	0.66	0.66
	15	745	10	12.8	12.8	0.66	0.62
	16	462	22	13.4	12.2	0.56	0.56
	17	632	14	13.9	13.9	0.52	0.39
	18	737	6	15.0	12.8	0.43	0.39
	19	40	3	14.5	12.8	0.43	0.36
	20	2,000	10	13.9	13.4	0.39	0.36
	21	1,930	6	14.5	12.8	0.36	0.30
	22	1,350	5	15.6	14.5	0.33	0.33
	23	780	4	14.5	13.4	0.33	0.33
	24	400	0	14.5	13.9	0.33	0.30
	25	1,450	19	13.9	13.4	0.30	0.30

Appendix 3c (cont'd.)

Date		Smolts	Kelts	Water Temperature Max.	Min.	Water Height Max.	Min.
June	26	20	1	12.8	10.0	0.30	0.26
	27	20	0	11.1	10.0	0.23	0.13
	28	0	0	11.1	11.1	0.13	0.13
	29	50	2	14.5	13.4	0.66	0.49
	30	400	6	16.7	16.7	1.21	1.09
July	1	448	7	17.8	17.2	1.25	1.25
	2	910	8	16.7	15.6	1.21	1.18
	3	115	10	16.1	15.6	1.25	1.15
	4	250	6	13.9	12.8	1.21	1.15
	5	650	12	12.8	11.7	1.25	1.25
	6	1,980	8	10.6	10.0	1.25	1.21
	7	550	6	10.6	10.6	1.28	1.25
	8	540	2	12.8	10.6	1.28	1.25
	9	350	1	11.1	10.6	1.87	1.28
	10	220	2	11.1	10.0	1.51	1.31
	11	210	2	11.7	11.7	1.57	1.44
	12	30	0	10.6	8.9	1.71	1.51
	13	30	0	12.8	11.1	1.44	1.28
	14	26	0	15.6	15.6	1.21	1.15
	15	59	0	17.2	16.7	1.12	1.09
	16	55	1	17.2	16.7	1.28	1.18
	17	39	1	17.2	16.7	1.28	1.15
	18	42	1	16.1	15.6	1.18	1.15
	19	55	-	16.1	16.1	1.09	1.09
	20	10	-	16.1	16.1	1.12	1.12
	21	20	-	15.6	15.6	1.21	1.21
	22	18	-	13.9	13.9	1.31	1.31
	23	20	-	16.7	16.7	1.21	1.21
	24	25	-	17.2	17.2	1.18	1.18
	25	7	-	15.0	15.0	1.31	1.31
	26	15	-	15.6	15.6	1.18	1.18
Total		22,141	746	-	-	-	-

Appendix 3d. Daily smolt and kelt enumerations at the Bishop's Falls forebay, 1975. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
May	12	0	6	3.0	3.0	1.52	1.42
	13	0	19	4.0	3.0	1.40	1.37
	14	2	49	4.0	3.0	1.37	1.32
	15	3	46	4.0	3.0	1.37	1.30
	16	6	53	4.0	3.0	1.30	1.27
	17	18	42	3.0	3.0	1.27	1.27
	18	12	9	4.0	4.0	1.24	1.22
	19	32	19	4.0	4.0	1.24	1.14
	20	19	38	7.0	7.0	1.22	1.14
	21	41	52	7.0	7.0	0.94	0.84
	22	23	5	8.0	7.0	0.76	0.66
	23	155	28	9.0	8.0	0.71	0.46
	24	75	4	8.0	7.0	0.46	0.38
	25	60	7	8.0	8.0	0.46	0.41
	26	71	5	8.0	7.0	0.46	0.41
	27	86	3	9.0	8.0	0.43	0.41
	28	101	3	9.0	9.0	0.53	0.46
	29	135	1	9.0	9.0	0.51	0.41
	30	132	1	10.0	9.0	0.38	0.30
	31	144	3	9.0	9.0	0.36	0.30
June	1	90	12	10.0	10.0	0.74	0.30
	2	665	1	11.0	10.0	0.36	0.23
	3	60	11	12.0	12.0	0.74	0.23
	4	755	7	13.0	12.0	0.61	0.36
	5	420	15	12.0	12.0	0.41	0.30
	6	432	3	12.0	12.0	0.38	0.30
	7	120	0	12.0	11.0	0.30	0.20
	8	345	2	8.0	8.0	0.30	0.30
	9	395	4	9.0	8.0	0.41	0.33
	10	375	11	9.0	8.0	0.36	0.30
	11	850	7	9.0	9.0	0.38	0.20
	12	700	2	9.0	9.0	0.36	0.18
	13	420	2	10.0	9.0	0.18	0.15
	14	300	3	12.0	12.0	1.37	0.84
	15	61	19	13.0	12.0	1.12	1.12
	16	475	26	14.0	13.0	1.09	1.07
	17	800	24	14.0	14.0	1.09	1.04
	18	262	8	14.0	13.0	1.27	1.09
	19	700	10	14.0	13.0	1.22	1.12
	20	736	16	14.0	13.0	1.22	1.09
	21	260	5	14.0	13.0	1.24	1.02

Appendix 3d (cont'd).

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
June	22	1,575	3	14.0	14.0	1.09	1.04
	23	745	5	14.0	13.0	1.12	1.09
	24	375	3	14.0	14.0	1.27	1.22
	25	420	0	15.0	14.0	1.22	1.09
	26	770	0	15.0	14.0	1.27	1.22
	27	875	5	15.0	14.0	1.35	1.27
	28	600	3	16.0	15.0	1.30	1.27
	29	329	0	16.0	15.0	1.22	1.22
	30	693	0	16.0	15.0	1.70	1.63
July	1	220	0	16.0	16.0	1.65	1.63
	2	30	0	16.0	15.0	1.60	1.60
	3	8	0	16.0	16.0	1.60	1.60
	4	15	0	16.0	16.0	1.63	1.63
	5	15	0	16.0	16.0	1.55	1.55
	6	9	0	16.0	16.0	1.55	1.55
	7	15	0	16.0	16.0	1.63	1.63
	8	4	1	15.0	15.0	1.63	1.63
	9	10	-	16.0	16.0	1.57	1.57
	10	5	-	16.0	16.0	1.52	1.52
	11	FISHWAY CLOSED					
	12	3	-	16.0	16.0	1.57	1.57
	13	2	-	19.0	19.0	1.57	1.57
	14	-	-	19.0	19.0	1.57	1.57
	15	2	-	19.0	19.0	0.97	0.97
	16	6	-	19.0	19.0	1.02	1.02
Total		17,062	601	-	-	-	-

Appendix 3e. Daily smolt and kelt enumerations at the Bishop's Falls forebay, 1976. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
May	4	-	51	5.5	5.0	1.34	1.25
	5	1	205	5.0	5.0	1.92	1.89
	6	-	6	6.1	5.6	1.77	1.46
	7	-	5	5.6	5.0	1.40	1.28
	8	1	4	5.0	5.0	1.28	1.28
	9	FISHWAY CLOSED					
	10	0	6	7.0	7.0	1.52	1.51
	11	4	11	7.0	6.5	1.63	1.62
	12	8	9	7.0	7.0	1.55	1.25
	13	32	10	7.0	7.0	1.49	1.49
	14	26	22	8.0	8.0	1.47	1.10
	15	50	17	8.5	7.5	0.94	0.61
	16	20	19	8.0	8.0	0.91	0.88
	17	41	4	8.5	8.0	0.76	0.76
	18	222	16	10.0	9.0	0.67	0.61
	19	647	45	11.0	9.0	0.61	0.30
	20	243	13	12.0	11.0	0.30	0.15
	21	389	7	11.0	10.0	0.15	0.12
	22	112	2	12.0	10.0	0.12	0.12
	23	750	2	11.0	10.0	0.24	0.18
	24	1,633	86	11.0	11.0	0.49	0.46
	25	1,223	31	9.0	8.0	0.73	0.58
	26	196	7	8.0	7.0	0.85	0.61
	27	765	20	8.0	8.0	0.76	0.67
	28	89	0	9.0	7.0	0.52	0.24
	29	20	-	12.0	7.0	0.12	0.12
	30	2	0	10.0	10.0	0.12	0.09
	31	189	1	10.0	10.0	0.24	0.18
June	1	22	0	9.0	9.0	0.15	0.15
	2	395	3	8.0	8.0	0.55	0.43
	3	56	2	8.0	7.0	0.58	0.49
	4	84	0	10.0	10.0	0.43	0.30
	5	74	1	11.0	10.0	0.30	0.15
	6	15	0	12.0	11.0	0.18	0.09
	7	32	0	11.0	11.0	0.15	0.09
	8	89	0	11.0	10.0	0.55	0.09
	9	102	2	11.0	10.0	0.70	0.49
	10	200	17	11.0	10.0	0.98	0.79
	11	129	7	12.0	12.0	1.04	0.98
	12	100	2	11.0	10.0	1.07	0.98
	13	68	4	9.0	7.0	1.25	1.31

Appendix 3e (cont'd.)

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
June	14	83	2	10.0	9.0	1.34	0.25
	15	409	2	11.0	9.0	1.31	1.25
	16	649	5	12.0	11.5	1.28	1.25
	17	886	8	15.0	12.0	1.22	1.22
	18	1,216	9	17.0	17.0	1.16	0.94
	19	956	9	17.0	16.0	1.10	0.98
	20	1,054	4	17.0	17.0	1.10	0.98
	21	349	1	17.0	17.0	1.16	0.98
	22	322	2	17.0	17.0	1.04	0.98
	23	228	0	16.0	15.0	0.98	0.91
	24	385	1	14.0	14.0	0.98	0.88
	25	329	2	15.0	14.0	0.98	0.94
	26	316	0	13.0	13.0	0.94	0.91
	27	56	1	12.0	12.0	0.98	0.98
	28	77	0	12.0	12.0	0.98	0.98
	29	148	0	13.0	13.0	0.88	0.88
	30	149	0	13.0	13.0	0.91	0.88
July	1	59	0	13.0	12.0	0.98	0.88
	2	87	0	13.0	12.0	0.98	0.91
	3	202	1	14.0	13.0	1.07	0.98
	4	66	0	14.0	14.0	0.98	0.98
	5	50	0	15.0	15.0	1.04	0.98
	6	85	0	16.0	16.0	1.71	1.37
	7	55	0	16.0	16.0	0.98	0.98
	8	20	0	16.0	16.0	0.88	0.88
	9	14	1	19.0	18.0	0.88	0.85
	10	28	0	20.0	19.0	0.88	0.76
	11	15	0	19.0	19.0	0.94	0.91
	12	17	0	17.0	17.0	0.91	0.91
	13	20	0	17.0	17.0	0.88	0.88
	14	8	0	16.0	-	0.91	-
	15	15	-	15.0	-	0.91	-
	16	8	-	13.0	-	0.79	-
	17	3	0	15.0	-	0.61	-
	18	2	-	15.0	-	0.73	-
	19	7	-	16.0	-	1.01	-
	20	4	-	17.0	-	0.98	-
	21	14	-	17.0	-	0.98	-
Total		16,420	685	-	-	-	-

Appendix 3f. Daily smolt and kelt enumerations at the Bishop's Falls forebay, 1977. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
April	25	-	1	2.0	2.0	1.4	1.4
	26	-	1	2.0	2.0	1.4	1.4
	27	-	1	2.5	2.5	1.4	1.4
	28	-	-	3.0	3.0	1.4	1.4
	29	2	9	2.0	2.0	1.5	1.4
	30	6	18	2.0	2.0	1.4	1.4
May	1	7	12	3.0	2.5	1.2	1.2
	2	-	4	2.5	2.5	1.0	1.0
	3	-	3	3.8	3.8	1.0	1.0
	4	-	3	4.0	3.0	1.0	1.0
	5	-	-	4.0	4.0	1.0	0.7
	6	-	-	4.0	4.0	0.9	0.7
	7	FISHWAY CLOSED					
	8	FISHWAY CLOSED					
	9	1	4	4.0	4.0	0.8	0.7
	10	3	10	4.0	4.0	0.7	0.4
	11	-	18	4.0	4.0	0.6	0.4
	12	3	14	4.0	4.0	0.7	0.7
	13	2	23	4.0	4.0	0.9	0.9
	14	-	34	4.0	4.0	1.0	0.9
	15	7	51	4.0	4.0	1.2	1.2
	16	7	24	5.0	4.0	1.2	1.1
	17	5	22	5.0	5.0	1.2	1.1
	18	1	19	5.5	5.5	1.2	1.2
	19	2	16	5.5	5.5	1.0	0.6
	20	-	18	5.5	5.5	0.7	0.3
	21	2	21	5.5	5.5	1.0	0.9
	22	4	16	5.5	5.5	0.9	0.9
	23	9	36	8.0	5.0	1.2	0.6
	24	58	51	10.0	8.0	0.8	0.7
	25	97	25	11.0	10.0	0.7	0.6
	26	123	34	9.0	8.0	0.8	0.7
	27	32	4	7.0	6.0	1.3	1.1
	28	11	1	6.0	6.0	1.6	1.6
	29	27	11	7.0	6.0	1.6	1.5
	30	21	16	8.0	7.0	1.4	1.4
	31	132	30	9.0	8.0	1.1	0.5
June	1	667	31	12.0	10.0	0.9	0.8
	2	237	5	13.0	12.0	0.8	0.8
	3	395	15	13.5	13.0	0.6	0.6

Appendix 3f (cont'd.)

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
June	4	1,775	3	14.0	14.0	0.6	0.4
	5	290	2	14.0	14.0	0.4	0.4
	6	548	3	13.5	13.5	0.4	0.4
	7	327	2	11.5	11.5	0.5	0.5
	8	297	2	10.5	10.0	0.5	0.3
	9	376	1	13.0	13.0	0.6	0.5
	10	58	-	14.0	13.0	0.4	0.3
	11	708	1	16.0	14.0	0.3	0.2
	12	114	-	16.5	16.0	0.2	0.2
	13	212	-	17.0	16.0	0.2	0.2
	14	343	1	16.0	14.0	0.3	0.2
	15	353	-	14.0	13.5	0.3	0.2
	16	160	-	14.0	13.0	0.2	0.1
	17	112	-	11.0	10.0	0.3	0.2
	18	49	-	11.0	10.0	0.3	0.1
	19	4,556	9	13.5	13.0	0.1	0.1
	20	405	5	13.0	12.5	0.6	0.2
	21	247	-	13.0	12.0	0.6	0.2
	22	17	-	13.5	13.0	-	-
	23	102	1	11.5	10.0	0.7	0.6
	24	256	1	13.0	12.5	0.7	0.4
	25	26	-	14.0	14.0	0.8	0.8
	26	70	-	18.0	15.0	0.8	0.8
	27	160	-	16.5	16.0	0.9	0.9
	28	77	-	15.5	15.0	0.9	0.9
	29	145	1	18.0	18.0	0.9	0.9
	30	97	-	17.0	15.0	1.0	0.9
July	1	125	1	18.0	17.0	0.9	0.9
	2	94	-	17.0	17.0	0.9	0.8
	3	66	2	17.0	17.0	0.8	0.7
	4	172	-	17.0	17.0	0.9	0.7
	5	39	-	18.0	17.0	1.2	0.8
	6	30	-	16.0	16.0	0.9	0.9
	7	16	-	15.0	15.0	0.9	0.9
	8	34	-	16.0	16.0	1.0	1.0
	9	22	-	16.0	16.0	1.0	1.0
	10	11	1	17.0	16.0	1.0	0.9
	11	12	-	17.0	17.0	1.5	1.5

Bishop's forebay closed from 1:00 on July 11 until 08:00 July 18 due to Price shut-down operations.

Appendix 3f (cont'd.)

Date	Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
18	1	-	18.0	17.0	1.1	0.9
19	-	-	18.0	18.0	0.7	0.7
20	6	-	18.0	18.0	0.7	0.7
Total	14,369	637	-	-	-	-

Appendix 3g. Daily smolt and kelt enumerations at the Bishop's Falls forebay, 1978. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
May	1	-	5	2.5	2.5	1.3	1.3
	2	-	-	3.0	3.0	1.3	1.3
	3	-	-	2.0	2.0	1.3	1.3
	4	-	7	2.0	2.0	1.3	1.3
	5	-	3	2.0	2.0	1.3	1.3
	6	FISHWAY CLOSED					
	7	FISHWAY CLOSED					
	8	-	3	4.0	4.0	1.1	1.1
	9	-	13	6.0	5.0	1.2	1.1
	10	-	23	6.0	6.0	1.1	0.9
	11	-	30	7.0	5.0	1.2	1.1
	12	-	50	6.0	6.5	1.3	1.2
	13	-	39	7.0	6.0	1.3	1.2
	14	2	22	8.5	8.0	1.2	1.2
	15	-	36	9.0	9.0	1.2	1.2
	16	2	41	9.0	9.0	1.2	1.2
	17	1	12	10.0	9.0	1.1	1.0
	18	12	80	11.0	11.0	0.8	0.8
	19	26	27	12.5	11.0	0.7	0.6
	20	59	18	12.0	11.0	0.9	0.6
	21	50	16	12.5	10.5	0.5	0.5
	22	40	4	11.0	9.5	0.4	0.4
	23	16	5	9.0	7.0	0.4	0.3
	24	9	3	7.0	6.0	0.3	0.2
	25	12	-	7.5	7.0	0.2	0.2
	26	9	1	8.5	8.0	0.3	0.2
	27	4	-	8.5	8.0	0.3	0.3
	28	26	1	8.0	7.0	0.3	0.2
	29	8	-	7.5	7.0	0.4	0.3
	30	29	5	8.0	8.0	0.4	0.3
	31	102	96	9.0	8.0	0.5	0.4
June	1	119	23	10.0	9.0	0.4	0.4
	2	115	25	9.0	9.0	0.4	0.4
	3	92	6	10.0	9.0	0.4	0.4
	4	82	3	11.0	11.0	0.3	0.3
	5	12	7	11.0	10.0	0.5	0.4
	6	124	27	11.5	10.0	0.5	0.5
	7	253	3	13.0	12.0	0.5	0.4
	8	118	4	14.5	12.0	0.6	0.4
	9	68	3	13.5	12.5	0.4	0.4
	10	91	6	13.0	13.0	0.4	0.4

Appendix 3g (cont'd.)

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
June	11	148	14	13.0	12.5	0.5	0.4
	12	303	8	19.0	12.5	0.4	0.3
	13	849	21	16.0	15.0	0.4	0.3
	14	168	3	18.0	16.0	0.4	0.2
	15	255	53	18.0	17.0	0.7	0.6
	16	78	3	16.0	15.0	0.7	0.7
	17	45	1	14.0	14.0	0.7	0.7
	18	157	3	15.0	14.5	0.7	0.7
	19	581	5	17.0	14.0	1.1	1.0
	20	285	2	18.0	17.0	1.3	1.2
	21	555	4	19.0	19.0	1.1	1.0
	22	1,014	1	20.0	19.0	1.0	1.0
	23	547	1	18.5	18.0	1.0	1.0
	24	236	-	18.5	18.0	0.9	0.9
	25	247	2	19.0	18.5	1.0	0.9
	26	387	4	20.0	18.5	0.9	0.9
	27	284	4	19.5	18.5	1.1	0.9
	28	103	1	19.0	18.5	1.1	1.0
	29	171	1	18.0	17.0	1.1	0.9
	30	88	3	19.0	18.0	1.0	0.9
July	1	53	1	14.0	14.0	1.0	1.0
	2	67	2	15.0	14.5	1.1	1.0
	3	80	1	16.0	15.5	1.1	1.1
	4	81	1	16.5	16.0	1.1	1.1
	5	49	2	17.0	16.5	1.2	1.1
	6	74	6	17.5	17.0	1.1	1.1
	7	61	1	18.0	17.5	1.1	1.1
	8	35	1	19.0	18.5	1.1	1.1
	9	78	2	20.5	20.0	1.1	1.1
	10	95	-	22.0	21.5	1.1	1.1
	11	83	2	23.5	22.0	1.2	1.1
	12	80	1	22.0	22.0	1.4	1.2
Total		8,818	801	-	-	-	-

Appendix 3h. Daily smolt and kelt enumerations at the Bishop's Falls forebay, 1979. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
April	27	-	6	5.0	0.9	0.6	-
	28	-	26	6.0	5.0	0.6	0.5
	29	-	25	7.0	6.0	0.6	0.4
	30	2	9	8.0	8.0	0.5	0.4
May	1	-	-	9.0	9.0	0.4	0.4
	2	1	7	9.0	7.0	0.5	0.4
	3	1	9	6.0	5.0	0.6	0.5
	4	-	9	7.0	6.0	0.6	0.5
	5	2	11	7.0	7.0	0.5	0.4
	6	5	12	7.0	6.0	0.4	0.4
	7	2	9	7.0	6.0	0.8	0.6
	8	-	4	6.0	5.0	1.3	1.0
	9	1	87	7.0	5.0	1.3	1.3
	10	-	6	7.0	6.0	0.7	0.7
	11	-	-	8.0	7.5	0.5	0.5
	12	-	2	7.0	6.0	0.5	0.5
	13	-	-	8.5	8.0	0.6	0.5
	14	-	1	8.5	8.5	0.5	0.5
	15	1	45	8.0	8.0	0.7	0.7
	16	2	22	9.0	8.0	0.6	0.6
	17	5	31	14.0	12.0	0.5	0.5
	18	10	28	14.0	13.0	0.6	0.4
	19	12	4	16.0	15.0	0.5	0.4
	20	42	28	17.0	16.5	0.5	0.4
	21	33	19	16.5	16.0	0.5	0.4
	22	110	32	17.0	16.0	0.4	0.4
	23	5,558	545	17.0	14.5	0.5	0.4
	24	9,146	36	15.0	13.5	0.6	0.3
	25	3	-	17.0	13.0	0.4	0.4
	26	10	-	13.0	12.0	0.4	0.4
	27	12,014	59	13.0	12.0	0.7	0.4
	28	31	2	13.0	12.5	0.3	0.2
	29	15	-	13.0	13.0	0.5	0.2
	30	853	12	13.0	12.0	1.3	1.0
	31	650	6	16.0	14.0	1.1	1.1
June	1	452	2	18.0	15.0	1.1	1.0
	2	1,505	3	17.0	15.0	1.2	1.1
	3	18,062	5	16.0	15.0	1.5	1.1
	4	271	7	16.0	15.0	1.2	1.1
	5	7,657	3	16.0	14.0	1.3	1.1

Appendix 3h (cont'd.)

Date		Smolts	Kelts	Water Temperature Max.	Min.	Water Height Max.	Min.
June	6	280	-	16.0	15.0	1.1	1.1
	7	1,677	1	16.0	15.0	1.1	1.1
	8	1,186	-	16.0	15.0	1.1	1.1
	9	13,260	-	16.0	15.0	1.3	1.1
	10	4,536	-	16.0	16.0	1.3	1.0
	11	410	-	16.0	15.0	1.2	1.1
	12	4,292	2	17.0	16.0	1.8	1.2
	13	286	-	17.0	16.0	1.3	1.1
	14	575	-	17.0	16.0	1.1	1.0
	15	231	-	16.0	15.0	1.1	1.1
	16	142	-	16.0	14.0	1.1	1.1
	17	116	-	16.0	14.0	1.1	1.1
	18	159	1	16.0	15.0	1.1	1.1
	19	467	-	16.0	16.0	1.1	1.1
	20	318	-	16.0	14.0	1.1	1.1
	21	624	-	17.0	15.0	1.3	1.1
	22	744	-	17.0	17.0	1.3	1.1
	23	270	1	18.0	13.0	1.1	1.1
	24	205	-	20.0	19.0	1.1	1.1
	25	113	-	18.0	16.0	1.1	1.1
	26	89	-	17.0	16.0	1.1	1.1
	27	73	-	16.0	14.0	1.1	1.1
	28	81	-	16.0	15.0	1.1	1.1
	29	71	-	16.0	15.0	1.1	1.1
	30	75	-	18.0	17.0	1.1	1.1
July	1	43	-	18.0	16.0	1.3	1.1
	2	2	-	18.0	18.0	1.3	1.1
	3	-	-	17.0	17.0	1.3	1.3
	4	2	-	18.0	17.0	1.4	1.3
	5	FISHWAY CLOSED					
	6	FISHWAY CLOSED					
	7	-	-	17.0	17.0	1.1	1.1
	8	1	-	17.0	15.0	1.1	1.0
	9	6	-	17.0	16.0	1.2	1.2
	10	1	-	17.0	-	1.2	-
Total		86,791	1,117	-	-	-	-

Appendix 3i. Daily smolt and kelt enumerations at the Bishop's Falls forebay, 1980. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
April	28	-	5	4.0	3.0	1.4	1.4
	29	-	6	5.0	5.0	1.1	1.0
	30	-	11	6.0	5.0	1.0	0.9
May	1	-	9	7.0	6.0	0.8	0.7
	2	-	6	7.0	7.0	0.7	0.7
	3	-	20	7.5	7.0	0.7	0.6
	4	-	19	7.0	6.0	0.6	0.5
	5	-	12	6.0	6.0	0.6	0.3
	6	-	2	5.0	5.0	1.0	1.0
	7	-	7	5.0	4.0	1.0	1.0
	8	-	7	5.0	4.0	0.9	0.8
	9	-	6	5.0	5.0	0.9	0.8
	10	-	14	5.0	4.5	0.6	0.5
	11	-	8	6.0	5.0	0.7	0.6
	12	-	8	6.0	5.0	0.7	0.6
	13	-	22	8.0	7.0	0.6	0.6
	14	2	12	8.0	7.0	0.5	0.6
	15	-	11	7.0	7.0	0.6	0.5
	16	-	13	8.0	7.0	0.5	0.5
	17	1	14	10.0	8.0	0.5	0.5
	18	3	15	10.0	10.0	0.4	0.3
	19	1	9	12.0	10.0	0.4	0.3
	20	181	117	11.0	10.0	0.8	0.1
	21	106	459	10.0	10.0	0.8	0.4
	22	129	171	12.0	10.0	0.8	0.4
	23	10	8	10.0	8.0	0.6	0.5
	24	26	15	6.0	5.0	0.8	0.6
	25	33	15	5.0	5.0	0.8	0.8
	26	256	86	7.0	5.0	1.1	0.8
	27	251	175	8.0	7.0	1.1	0.8
	28	98	113	9.0	7.0	0.9	0.7
	29	456	109	10.0	10.0	0.9	0.7
	30	308	33	8.0	7.0	0.9	0.6
	31	60	5	9.0	8.0	0.5	0.5
June	1	60	13	11.0	10.0	0.5	0.5
	2	128	28	10.0	7.0	0.8	0.5
	3	587	118	7.0	6.0	1.4	1.3
	4	541	13	6.0	5.0	1.4	1.3
	5	458	5	7.0	6.0	1.4	1.4
	6	784	8	6.0	5.0	1.4	1.4

Appendix 3i (cont'd.)

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
June	7	664	16	3.0	3.0	1.3	1.2
	8	872	13	8.0	8.0	1.2	1.2
	9	1,906	31	12.0	11.0	1.4	1.2
	10	912	14	12.0	10.0	1.4	1.2
	11	1,481	7	13.0	12.0	1.4	1.2
	12	1,409	4	11.0	10.0	1.2	1.0
	13	1,308	4	13.0	12.0	1.1	0.7
	14	350	2	14.0	13.0	0.6	0.6
	15	1,150	1	15.0	14.0	0.5	0.5
	16	754	-	13.0	11.0	0.9	0.8
	17	459	-	12.0	11.0	1.5	0.9
	18	967	-	15.0	12.0	1.6	0.9
	19	846	1	15.0	13.0	0.9	0.7
	20	894	-	14.0	13.0	0.7	0.7
	21	493	1	14.0	13.0	1.0	0.9
	22	500	-	14.0	13.0	1.0	0.9
	23	392	-	15.0	14.0	0.9	0.7
	24	736	-	16.0	15.0	1.0	0.7
	25	115	-	16.0	15.0	0.8	0.8
	26	57	1	18.0	17.0	0.6	0.6
	27	132	-	19.0	18.0	0.5	0.5
	28	-	-	18.0	17.0	0.9	0.5
	29	3	-	16.0	15.0	0.9	0.9
	30	-	-	14.0	14.0	0.9	0.9
July	1	1	-	14.0	13.0	0.9	0.9
	2	2	-	14.0	14.0	1.0	1.0
	3	3	-	14.0	14.0	1.0	1.0
	4	5	-	15.0	15.0	0.9	0.9
	5	13	-	16.0	16.0	0.9	0.9
	6	10	-	16.0	16.0	1.0	1.0
	7	14	-	16.0	16.0	1.0	1.0
	8	2	-	13.0	13.0	1.0	1.0
	9	-	-	14.0	14.0	1.0	1.0
	10	-	-	15.0	15.0	0.9	0.9
	11	2	-	14.0	14.0	1.0	1.0
Total		20,931	1,822	-	-	-	-

Appendix 3j. Daily smolt and kelt enumerations at the Bishop's Falls forebay, 1981. Water temperature (°C) and water height (m) included.

Date		Smolts	Kelts	Water Temperature Max.	Water Temperature Min.	Water Height Max.	Water Height Min.
May	4	-	4	-	-	-	-
	5	-	-	-	-	-	-
	6	-	57	-	-	-	-
	7	-	144	-	-	-	-
	8	-	53	-	-	-	-
	9	-	56	-	-	-	-
	10	1	36	-	-	-	-
	11	17	77	8.0	7.0	0.6	1.2
	12	18	50	9.0	8.0	0.9	0.9
	13	26	53	8.0	8.0	0.8	0.8
	14	57	19	8.0	7.0	0.8	0.8
	15	210	36	8.0	7.0	0.8	0.7
	16	132	8	11.0	8.0	0.5	0.5
	17	145	4	12.0	10.0	0.4	0.4
	18	1,418	17	12.0	11.0	0.4	0.4
	19	818	177	-	-	-	-
	20	537	63	9.0	8.0	0.7	0.2
	21	15	1	9.0	7.0	0.4	0.2
	22	1,133	95	11.0	9.0	0.6	0.2
	23	1,532	80	12.0	10.0	0.7	0.2
	24	917	25	10.0	9.0	0.6	0.3
	25	137	6	9.0	9.0	0.6	0.3
	26	315	19	9.0	8.0	0.5	0.3
	27	543	19	8.0	7.0	0.7	0.3
	28	101	0	10.0	9.0	0.4	0.2
	29	1,706	20	12.0	11.0	0.7	0.3
	30	2,700	31	13.0	12.0	0.7	0.4
	31	2,547	43	13.0	13.0	0.7	0.3
June	1	2,465	21	13.0	13.0	0.5	0.2
	2	971	9	13.0	13.0	0.6	0.3
	3	44	0	14.0	13.0	0.2	0.3
	4	2,612	43	15.0	14.0	1.0	1.2
	5	2,136	7	15.0	14.0	1.1	1.0
	6	1,278	3	14.0	14.0	1.1	1.0
	7	2,603	11	14.0	13.0	1.6	1.3
	8	2,237	5	14.0	13.0	1.4	1.1
	9	5,285	1	13.0	12.0	1.4	1.3
	10	1,136	0	-	-	-	-
	11	2,279	0	-	-	-	-
	12	1,375	0	13.0	11.0	1.2	1.2
	13	2,092	0	11.0	10.0	1.2	1.2

Appendix 3j (cont'd.)

Date		Smolts	Kelts	Water Temperature Max.	Min.	Water Height Max.	Min.
June	14	4,361	0	13.0	12.0	1.3	1.1
	15	2,109	0	14.0	14.0	1.1	1.1
	16	1,240	0	13.0	12.0	1.1	1.1
	17	160	0	13.0	12.0	1.4	1.1
	18	1,005	0	15.0	13.0	1.3	1.1
	19	933	0	14.0	14.0	1.4	1.1
	20	655	1	16.0	15.0	1.1	1.1
	21	854	1	17.0	15.0	1.2	1.0
	22	472	3	16.0	13.0	1.7	1.3
	23	605	1	15.0	13.0	1.5	1.4
	24	1,126	0	16.0	15.0	1.4	1.3
	25	718	0	17.0	16.0	1.4	1.2
	26	816	1	16.0	16.0	1.2	1.2
	27	898	0	16.0	16.0	1.2	1.1
	28	995	0	16.0	16.0	1.1	1.1
	29	348	0	18.0	17.0	1.1	1.0
	30	321	0	18.0	18.0	1.1	1.1
July	1	344	0	19.0	18.0	1.1	1.1
	2	50	0	20.0	19.0	1.1	1.0
	3	92	0	18.0	18.0	1.1	1.0
	4	73	0	-	-	-	-
	5	96	0	-	-	-	-
	6	11	0	-	-	-	-
Total		59,820	1,300	-	-	-	-

APPENDIX 4: WEEKLY SMOLT AND KELT ENUMERATIONS AT THE BISHOP'S FALLS FOREBAY FOR THE YEARS 1972-81

Appendix 4a. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1972. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature
April	29	1	2	1.7
May	6	-	7	2.4
	13	-	-	1.9
	20	3	21	4.9
	27	8	19	5.8
June	3	618	99	11.6
	10	2,421	28	11.0
	17	3,546	13	14.2
	24	1,878	10	15.5
July	1	1,442	10	13.4
	8	22	1	16.4
	15	-	-	-
Total		9,939	210	-

Appendix 4b. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1973. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature Max.	Min.
May	12	-	1	3.8	3.4
	19	-	15	6.6	5.6
	26	13	12	7.2	5.6
June	2	10	23	11.5	9.8
	9	2,326	32	14.4	11.7
	16	2,564	41	11.0	8.9
	23	4,641	34	12.8	10.0
	30	5,146	21	17.1	14.8
July	7	764	1	21.3	19.5
	14	215	-	21.6	20.4
	21	7	-	22.2	22.2
	28	12	-	22.2	21.1
Total		15,698	180	-	-

Appendix 4c. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1974. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature Max.	Min.
May	18	2	11	4.5	4.1
	25	4	64	7.5	6.6
June	1	18	142	4.2	3.6
	8	994	235	7.9	6.1
	15	4,178	129	9.1	8.0
	22	7,151	66	14.4	13.2
	29	2,720	26	13.2	12.2
July	6	4,753	57	14.9	14.2
	13	1,930	13	11.5	10.5
	20	286	3	16.5	16.2
	27	105	-	15.7	15.7
Total		22,141	746	-	-

Appendix 4d. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1975. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature Max.	Min.
May	17	29	215	3.7	3.0
	24	357	155	6.7	6.3
	31	729	23	8.9	8.4
June	7	2,542	49	11.7	11.3
	14	3,385	31	9.4	9.0
	21	3,294	108	13.9	13.0
	28	5,360	19	14.7	14.0
July	5	1,310	-	16.0	15.6
	12	46	1	15.8	15.8
	19	10	-	19.0	19.0
Total		17,062	601	-	-

Appendix 4e. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1976. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature Max.	Min.
May	8	2	271	5.4	5.1
	15	120	75	7.4	7.2
	22	1,674	106	10.4	9.3
	29	4,676	146	9.7	8.3
June	5	822	7	9.4	9.1
	12	667	28	11.3	10.6
	19	4,267	39	13.0	11.6
	26	2,983	10	15.6	15.3
July	3	778	2	12.9	12.4
	10	318	1	16.6	16.3
	17	86	-	17.7	17.7
	24	27	-	16.3	-
Total		16,420	685	-	-

Appendix 4f. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1977. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature Max.	Min.
April	30	8	30	2.3	2.3
May	7	7	22	3.6	3.3
	14	9	103	4.0	4.0
	21	24	171	5.1	5.0
	28	334	167	8.1	6.9
June	4	3,254	111	10.9	10.0
	11	2,604	11	13.2	12.7
	18	1,343	1	14.2	13.2
	25	5,609	16	13.1	12.4
July	2	768	2	17.1	16.1
	9	379	2	16.4	16.3
	16	23	1	17.0	16.5
	23	7	-	18.0	17.7
Total		14,369	637	-	-

Appendix 4g. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1978. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature Max.	Min.
May	6	-	15	2.3	2.3
	13	-	158	6.2	5.4
	20	102	236	10.3	9.7
	27	140	29	9.1	8.0
June	3	491	156	8.8	8.1
	10	748	53	12.5	11.5
	17	1,846	103	16.3	14.6
	24	3,375	16	18.0	17.1
July	1	1,333	16	18.4	17.6
	8	447	14	17.0	16.5
	15	336	5	22.0	21.4
Total		8,818	801	-	-

Appendix 4h. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1979. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature Max.	Min.
April	28	-	32	5.5	3.0
May	5	6	70	7.6	6.9
	12	8	120	7.0	5.9
	19	30	131	11.1	10.4
	26	14,902	660	16.1	14.5
June	2	15,520	84	14.7	13.4
	9	42,393	16	16.0	14.9
	16	10,472	2	16.4	15.4
	23	2,698	2	16.6	14.9
	30	707	-	17.3	16.0
July	7	47	-	17.6	17.0
	14	8	-	17.0	15.5
Total		86,791	1,117	-	-

Appendix 4i. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1980. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature Max.	Min.
May	3	-	57	6.1	5.5
	10	-	67	5.4	4.9
	17	3	88	7.6	6.6
	24	456	794	10.1	9.0
	31	1,462	536	8.0	7.0
June	7	3,222	201	7.1	6.0
	14	8,238	75	11.9	10.9
	21	5,563	3	14.0	12.4
	28	1,932	1	16.6	15.6
July	5	27	-	14.7	14.4
	12	28	-	14.7	14.7
Total		20,931	1,822	-	-

Appendix 4j. Weekly smolt and kelt enumerations at the Bishop's Falls forebay, 1981. Mean weekly water temperature (°C) included.

Week Ending		Smolts	Kelts	Mean Water Temperature Max.	Min.
May	9	-	314	-	-
	16	461	279	8.7	7.5
	23	5,598	437	10.8	9.2
	30	6,419	120	10.1	9.3
June	6	12,053	126	13.9	13.4
	13	17,007	17	13.0	11.8
	20	10,463	1	14.0	13.1
	27	5,489	6	16.1	14.9
July	4	2,223	-	18.2	17.7
	11	107	-	-	-
Total		59,820	1,300	-	-

APPENDIX 5: DAILY ADULT COUNT AT THE GRAND FALLS COLLECTION FACILITY FOR THE YEARS 1974-81

Appendix 5a. Daily adult count at the Grand Falls collection facility, 1974. Mean daily water temperature (°C) included.

Date		Temperature	(<62 cm)	(≥62 cm)
July	21	16.7	-	-
	22	17.2	-	-
	23	16.1	-	-
	24	17.8	-	-
	25	17.2	-	-
	26	17.2	-	-
	27	17.8	-	-
	28	16.1	-	-
	29	15.6	1	-
	30	14.4	-	-
	31	15.0	-	-
Aug.	1	15.6	1	-
	2	14.4	4	-
	3	17.2	1	-
	4	18.3	2	-
	5	17.2	5	-
	6	15.0	8	-
	7	14.4	2	-
	8	11.1	6	-
	9	8.9	2	-
	10	10.0	-	-
	11	11.1	-	-
	12	12.2	-	-
	13	10.0	1	-
	14	16.0	8	-
	15	15.0	-	-
	16	15.0	-	-
	17	16.0	-	-
	18	16.0	-	-
	19	16.0	1	-
	20	16.0	6	-
	21	16.0	3	-
	22	18.0	1	-
	23	17.0	2	-
	24	10.0	1	-
	25	8.9	-	-
	26	14.0	-	-
	27	13.0	-	-
	28	15.0	-	-
	29	15.0	-	-

Appendix 5a (cont'd.)

Date		Temperature	(<62 cm)	(≥62 cm)
Aug.	30	14.0	-	-
	31	14.0	-	-
Sept.	1	15.0	2	-
	2	15.0	1	-
	3	15.0	-	-
	4	16.0	2	-
	5	14.0	2	-
	6	13.0	-	-
	7	8.9	-	-
	8	8.9	-	-
	9	8.9	-	-
	10	10.0	-	-
	11	7.8	2	-
	12	8.9	-	-
	13	14.0	-	-
	14	15.0	-	-
Total			64	0

Appendix 5b. Daily adult count at the Grand Falls collection facility, 1975. Mean daily water temperature (°C) included.

Date		Temperature	(<62 cm)	(≥62 cm)
July	3	15.0	-	-
	4	16.0	-	-
	5	16.0	-	-
	6	15.0	-	-
	7	-	-	-
	8	-	-	-
	9	-	1	-
	10	-	3	-
	11	-	11	-
	12	-	-	-
	13	19.0	5	3
	14	21.0	8	-
	15	21.0	-	-
	16	20.0	11	-
	17	20.0	2	-
	18	17.0	17	-
	19	19.0	7	-
	20	22.0	7	-
	21	23.0	20	-
	22	21.0	4	-
	23	18.0	11	3
	24	20.0	31	10
	25	18.0	25	2
	26	18.0	8	-
	27	19.0	7	-
	28	18.0	14	-
	29	19.0	18	-
	30	19.0	14	-
	31	17.0	16	-
Aug.	1	16.0	8	1
	2	16.0	-	-
	3	16.0	-	-
	4	17.0	-	-
	5	18.0	1	-
	6	14.0	1	-
	7	18.0	-	-
	8	14.0	2	-
	9	15.0	3	-
	10	16.0	4	-
	11	17.0	11	-
	12	20.0	4	-

Appendix 5b (cont'd.)

Date		Temperature	(<62 cm)	(≥62 cm)
Aug.	13	19.0	13	-
	14	18.0	3	-
	15	15.0	1	-
	16	17.0	5	-
	17	16.0	2	-
	18	15.0	9	-
	19	16.0	2	-
	20	14.5	1	-
	21	10.0	-	-
	22	15.0	-	-
	23	14.0	-	-
	24	13.0	-	-
	25	14.0	-	-
	26	-	-	-
	27	14.0	4	-
	28	14.0	4	-
	29	16.0	-	-
	30	15.0	-	-
	31	15.0	-	-
Sept.	1	13.0	-	-
	2	13.0	1	-
	3	14.0	-	-
	4	14.0	-	-
	5	13.0	-	-
	6	14.0	1	-
	7	-	-	-
	8	-	-	-
	9	-	1	-
Total			321	19

Appendix 5c. Daily adult count at the Grand Falls collection facility, 1976. Mean daily water temperature (°C) included.

Date		Temperature	(<62 cm)	(≥62 cm)
July	18	21.1	5	1
	19	19.4	6	-
	20	18.3	2	-
	21	18.0	3	-
	22	17.0	6	-
	23	-	1	-
	24	-	5	-
	25	18.0	2	-
	26	19.0	3	-
	27	18.0	6	-
	28	17.0	-	-
	29	17.0	2	-
	30	17.0	4	-
	31	17.0	1	-
Aug.	1	18.0	9	1
	2	18.0	2	-
	3	17.0	2	-
	4	18.0	13	-
	5	18.0	5	1
	6	17.0	6	-
	7	17.0	2	-
	8	18.0	1	-
	9	18.0	1	-
	10	18.0	-	-
	11	18.0	8	-
	12	21.0	7	-
	13	21.0	8	-
	14	18.0	3	-
	15	17.0	1	-
	16	15.0	8	-
	17	15.0	-	-
	18	16.0	1	-
	19	15.0	-	-
	20	16.0	-	-
	21	17.0	-	-
	22	19.0	-	-
	23	21.0	-	-
	24	19.0	-	-
	25	17.0	-	-
	26	15.0	-	-
	27	15.0	-	-

Appendix 5c (cont'd.)

Date		Temperature	(<62 cm)	(≥62 cm)
Aug.	28	16.0	-	-
	29	17.0	-	-
	30	17.0	-	-
	31	17.0	1	1
Sept.	1	17.0	-	-
	2	17.0	-	-
	3	17.0	-	-
	4	15.0	1	-
	5	16.0	-	-
	6	16.0	-	-
	7	16.0	-	-
	8	16.0	-	-
	9	14.0	-	-
	10	15.0	-	-
	11	15.0	-	-
	12	16.0	-	-
	13	17.0	-	-
	14	16.0	-	-
	15	16.0	-	-
	16	14.0	-	-
	17	14.4	-	-
	18	17.0	-	-
	19	16.0	-	-
	20	16.0	-	-
Total			125	4

Appendix 5d. Daily adult count at the Grand Falls collection facility, 1977. Mean daily water temperature (°C) included.

Date		Temperature	(<62 cm)	(≥62 cm)
July	7	16.0	1	-
	8	16.0	-	-
	9	16.5	3	-
	10	-	3	-
	11	-	1	-
	12	-	-	-
	13	-	-	-
	14	-	7	-
	15	-	-	-
	16	-	-	-
	17	-	29	-
	18	-	24	1
	19	17.0	15	1
	20	17.0	33	2
	21	17.0	16	-
	22	16.0	6	-
	23	14.0	-	-
	24	14.0	2	-
	25	14.0	-	-
	26	14.0	-	-
	27	14.0	6	-
	28	14.0	4	-
	29	14.0	21	3
	30	15.0	13	1
	31	17.5	9	-
Aug.	1	17.0	-	-
	2	17.0	8	-
	3	18.0	1	-
	4	20.0	2	-
	5	20.0	-	-
	6	20.0	7	-
	7	18.0	-	-
	8	18.0	14	-
	9	18.0	-	-
	10	17.0	1	1
	11	16.0	4	-
	12	16.0	-	-
	13	16.0	-	-
	14	16.0	-	-
	15	15.0	4	-
	16	15.0	-	-

Appendix 5d (cont'd).

Date		Temperature	(<62 cm)	(≥62 cm)
Aug.	17	16.0	-	-
	18	16.0	1	-
	19	16.0	-	-
	20	17.0	-	-
	21	-	3	-
	22	-	-	-
	23	-	-	-
	24	-	-	-
	25	-	-	-
	26	16.0	-	-
	27	16.0	2	-
	28	16.0	-	-
	29	16.0	-	-
	30	18.0	1	-
	31	18.0	-	-
Sept.	1	17.0	-	-
	2	16.0	-	-
	3	15.0	1	-
	4	15.0	-	-
	5	14.0	-	-
	6	14.0	-	-
	7	13.0	-	-
	8	12.0	-	-
	9	12.0	-	-
	10	11.0	-	-
	11	15.0	-	-
	12	15.0	-	-
	13	15.0	-	-
	14	13.0	-	-
	15	12.0	-	-
	16	10.0	1	-
	17	10.0	-	-
	18	10.0	-	-
	19	9.5	-	-
	20	9.5	-	-
	21	9.5	-	-
	22	10.0	-	-
Total			243	9

Appendix 5e. Daily adult count at the Grand Falls collection facility, 1978. Mean daily water temperature (°C) included.

Date		Temperature	(<62 cm)	(≥62 cm)
July	5	-	-	-
	6	-	-	-
	7	-	-	-
	8	-	-	-
	9	-	-	-
	10	-	-	-
	11	-	-	-
	12	18.0	1	-
	13	18.0	11	1
	14	19.0	2	-
	15	20.0	1	-
	16	20.0	8	-
	17	20.0	14	1
	18	21.0	8	-
	19	19.0	16	3
	20	20.0	3	-
	21	20.0	8	-
	22	20.0	9	-
	23	20.0	9	-
	24	19.0	-	-
	25	19.0	-	-
	26	18.0	-	-
	27	18.0	-	-
	28	18.0	-	-
	29	19.0	-	-
	30	20.0	-	-
	31	20.0	-	-
Aug.	1	20.0	6	-
	2	20.0	2	-
	3	19.0	-	-
	4	21.0	-	-
	5	20.0	2	-
	6	21.0	-	-
	7	21.0	-	-
	8	20.0	-	-
	9	20.0	-	-
	10	18.0	-	-
	11	20.0	-	-
	12	20.0	-	-
	13	19.0	-	-
	14	20.0	2	1

Appendix 5e (cont'd.)

Date		Temperature	(<62 cm)	(≥62 cm)
Aug.	15	19.0	-	-
	16	19.0	-	-
	17	18.0	1	-
	18	18.0	-	-
	19	20.0	1	-
	20	17.0	-	-
	21	17.0	-	-
	22	18.0	-	-
	23	18.0	-	-
	24	18.0	2	-
	25	17.0	-	-
	26	19.0	-	-
	27	18.0	-	-
	28	19.0	-	-
	29	19.0	2	-
	30	-	-	-
	31	-	1	-
Sept.	1	-	-	-
	2	-	-	-
	3	18.0	-	-
	4	18.0	-	-
	5	15.0	2	-
	6	13.0	-	-
	7	11.0	-	-
	8	11.0	-	-
	9	11.0	-	-
	10	10.0	1	-
	11	10.0	-	-
	12	9.0	4	-
	13	10.0	-	-
	14	9.0	1	-
	15	8.0	-	-
	16	8.0	1	-
	17	11.0	2	-
	18	10.0	-	-
	19	9.0	5	-
	20	9.0	-	-
	21	11.0	-	-
	22	10.0	-	-
	23	11.0	3	-

Appendix 5e (cont'd.)

Date	Temperature	(<62 cm)	(≥62 cm)
Sept. 24	12.0	-	-
25	11.0	4	-
Total		132	6

Appendix 5f. Daily adult count at the Grand Falls collection facility, 1979. Mean daily water temperature (°C) included.

Date		Temperature	(<62 cm)	(≥62 cm)
July	5	-	3	-
	6	17.0	-	-
	7	14.0	1	-
	8	16.0	-	-
	9	16.0	-	-
	10	16.0	21	1
	11	17.0	-	1
	12	17.0	16	-
	13	16.0	11	-
	14	16.0	3	-
	15	14.0	1	-
	16	-	26	2
	17	16.0	-	-
	18	15.0	11	-
	19	15.0	5	-
	20	16.0	3	-
	21	19.0	48	2
	22	19.0	12	-
	23	19.0	27	1
	24	18.0	15	-
	25	17.0	5	-
	26	-	-	-
	27	20.0	-	-
	28	-	-	-
	29	-	5	-
	30	18.0	21	-
	31	21.0	5	-
Aug.	1	-	41	-
	2	20.0	20	-
	3	-	10	-
	4	10.0	15	-
	5	-	2	-
	6	20.0	36	-
	7	-	23	-
	8	17.0	27	-
	9	17.0	9	-
	10	17.0	15	-
	11	17.0	6	-
	12	17.0	3	-
	13	17.0	2	-
	14	16.0	4	-

Appendix 5f (cont'd.)

Date		Temperature	(<62 cm)	(≥62 cm)
Aug.	15	-	-	-
	16	-	-	-
	17	-	1	-
	18	-	2	-
	19	-	-	-
	20	-	-	-
	21	-	-	-
	22	-	-	-
	23	-	-	-
	24	17.0	-	-
	25	17.0	-	-
	26	-	-	-
	27	-	-	-
	28	-	-	-
	29	-	-	-
	30	-	-	-
	31	-	-	-
Sept.	1	-	-	-
	2	-	-	-
	3	-	-	-
	4	17.0	-	-
	5	16.0	-	-
	6	16.0	-	-
	7	17.0	-	-
	8	17.0	-	-
	9	17.0	-	-
	10	17.0	-	-
	11	17.0	-	-
	12	17.0	-	-
	13	-	-	-
	14	-	-	-
	15	-	-	-
	16	-	-	-
	17	-	-	-
	18	-	-	-
	19	-	-	-
	20	-	-	-
	21	-	-	-
	22	-	-	-
	23	-	-	-

Appendix 5f (cont'd.)

Date	Temperature	(<62 cm)	(≥62 cm)
Sept. 24	-	-	-
25	-	-	-
Total		455	7

Appendix 5g. Daily adult count at the Grand Falls collection facility, 1980. Mean daily water temperature (°C) included.

Date		Temperature	(<62 cm)	(≥62 cm)
July	5	-	-	-
	6	16.0	1	-
	7	16.0	3	-
	8	14.0	5	-
	9	14.0	3	-
	10	14.0	8	-
	11	14.0	5	-
	12	14.0	7	1
	13	16.0	25	-
	14	17.0	35	-
	15	16.0	11	1
	16	15.0	10	-
	17	15.0	27	-
	18	17.0	30	-
	19	17.0	127	-
	20	17.0	96	1
	21	18.0	55	2
	22	18.0	73	-
	23	14.0	25	-
	24	16.0	10	1
	25	16.0	-	-
	26	17.0	-	-
	27	17.0	-	-
	28	17.0	-	-
	29	18.0	-	-
	30	21.0	-	-
	31	14.0	-	-
Aug.	1	-	1	-
	2	-	98	-
	3	-	195	-
	4	15.0	186	-
	5	13.0	301	2
	6	14.0	270	-
	7	15.0	121	1
	8	15.0	183	-
	9	16.0	141	-
	10	17.0	228	-
	11	15.0	133	-
	12	14.0	31	-
	13	15.0	44	-
	14	15.0	119	-

Appendix 5g (cont'd.)

Date		Temperature	(<62 cm)	($\geq$62 cm)
Aug.	15	13.0	24	-
	16	13.0	15	-
	17	13.0	-	-
	18	10.0	-	-
	19	10.0	2	-
	20	12.0	23	-
	21	13.0	12	-
	22	14.0	23	-
	23	16.0	83	-
	24	14.0	48	-
	25	13.0	23	1
	26	13.0	21	-
	27	12.0	24	-
	28	14.0	31	-
	29	13.0	13	-
	30	14.0	13	-
	31	13.0	24	2
Sept.	1	14.0	12	1
	2	14.0	24	-
	3	16.0	-	-
	4	-	10	-
	5	-	4	-
	6	-	1	-
	7	-	3	-
	8	-	6	-
	9	-	6	-
	10	-	4	-
	11	-	4	-
	12	-	-	-
	13	-	-	-
	14	-	-	-
	15	-	-	-
	16	-	-	-
	17	-	-	-
	18	-	-	-
	19	-	-	-
	20	-	-	-
	21	-	-	-
	22	-	-	-
	23	-	-	-

Appendix 5g (cont'd.)

Date	Temperature	(<62 cm)	(≥62 cm)
Sept. 24	-	-	-
25	-	-	-
Total		3,060	13

Appendix 5h. Daily adult count at the Grand Falls collection facility, 1981. Mean daily water temperature (°C) included.

Date		Temperature	(<62 cm)	($\geq$62 cm)
July	8	-	4	0
	9	-	33	0
	10	-	28	0
	11	-	30	4
	12	-	0	0
	13	-	12	0
	14	-	65	6
	15	-	25	0
	16	-	28	2
	17	14.0	23	2
	18	17.0	40	1
	19	18.0	152	10
	20	20.0	147	5
	21	18.0	107	3
	22	20.0	100	3
	23	18.0	100	2
	24	18.0	80	2
	25	18.0	101	1
	26	18.0	134	2
	27	18.0	137	3
	28	18.0	147	4
	29	17.0	301	10
	30	17.0	151	9
	31	17.0	134	11
Aug.	1	17.0	93	12
	2	19.0	91	10
	3	19.0	89	7
	4	19.0	254	15
	5	20.0	64	0
	6	18.0	106	5
	7	15.0	24	0
	8	15.0	6	0
	9	12.0	0	0
	10	15.0	17	3
	11	16.0	28	5
	12	19.0	63	7
	13	20.0	36	3
	14	19.0	300	22
	15	19.0	60	6
	16	15.0	60	6
	17	17.0	54	5

Appendix 5h (cont'd.)

Date		Temperature	(<62 cm)	(≥62 cm)
Aug.	18	17.0	40	6
	19	16.0	18	1
	20	15.0	28	2
	21	15.0	10	0
	22	17.0	25	1
	23	18.0	45	6
	24	18.0	38	5
	25	15.0	13	2
	26	16.0	8	2
	27	18.0	4	2
	28	15.0	11	0
	29	15.0	10	2
	30	16.0	13	1
	31	16.0	24	3
Sept.	1	17.0	13	2
	2	18.0	8	2
	3	17.0	6	0
	4	17.0	14	4
	5	17.0	4	0
	6	18.0	5	0
	7	18.0	0	0
	8	-	9	0
	9	-	7	0
	10	-	3	0
	11	-	0	0
	12	-	0	0
	13	-	0	0
	14	-	6	0
	15	-	5	0
	16	-	4	0
Total			3,795	227

APPENDIX 6: WEEKLY ADULT COUNT AT THE GRAND FALLS COLLECTION FACILITY FOR THE YEARS 1974-81

Appendix 6a. Weekly adult count at the Grand Falls collection facility, 1974. Mean weekly water temperature (°C) included.

Week Ending	(<62 cm)	(≥62 cm)	Mean Water Temperature
July 27	0	0	17.1
Aug. 3	7	0	15.5
10	25	0	13.5
17	9	0	14.6
24	14	0	15.6
31	0	0	13.4
Sept. 7	7	0	13.8
14	2	0	10.5
Total	64	0	-

Appendix 6b. Weekly adult count at the Grand Falls collection facility, 1975. Mean weekly water temperature (°C) included.

Week Ending		(<62 cm)	(≥62 cm)	Mean Water Temperature
July	5	0	0	15.7
	12	15	0	15.0
	19	50	3	19.6
	26	106	15	20.0
Aug.	2	77	1	17.7
	9	7	0	16.0
	16	41	0	17.4
	23	14	0	14.4
	30	8	0	14.3
Sept.	6	2	0	13.7
	13	1	0	-
Total		321	19	-

Appendix 6c. Weekly adult count at the Grand Falls collection facility, 1976. Mean weekly water temperature (°C) included.

Week Ending		(<62 cm)	($\geq$62 cm)	Mean Water Temperature
July	17	0	0	-
	24	28	1	19.7
	31	18	0	17.6
Aug.	7	39	2	17.6
	14	28	0	18.9
	21	10	0	15.9
	28	0	1	17.4
Sept.	4	2	0	16.7
	11	0	0	15.4
	18	0	0	15.8
Total		125	4	-

Appendix 6d. Weekly adult count at the Grand Falls collection facility, 1977. Mean weekly water temperature (°C) included.

Week Ending		(<62 cm)	(≥62 cm)	Mean Water Temperature
July	9	4	0	16.2
	16	11	0	-
	23	123	4	16.2
	30	46	4	14.1
Aug.	6	27	0	18.5
	13	19	1	17.0
	20	5	0	15.9
	27	5	0	16.0
Sept.	3	2	0	16.6
	10	0	0	13.0
	17	1	0	12.9
	24	0	0	9.7
Total		243	9	-

Appendix 6e. Weekly adult count at the Grand Falls collection facility, 1978. Mean weekly water temperature (°C) included.

Week Ending		(<62 cm)	(≥62 cm)	Mean Water Temperature
July	8	0	0	-
	15	15	1	18.8
	22	66	4	20.0
	29	9	0	18.7
Aug.	5	10	0	20.0
	12	0	0	20.0
	19	4	1	19.0
	26	2	0	17.7
Sept.	2	3	0	12.3
	9	2	0	13.9
	16	7	0	9.1
	23	10	0	10.1
	30	4	0	11.5
Total		132	6	-

Appendix 6f. Weekly adult count at the Grand Falls collection facility, 1979. Mean weekly water temperature (°C) included.

Week Ending		(<62 cm)	(≥62 cm)	Mean Water Temperature
July	7	4	0	15.5
	14	51	2	16.3
	21	94	4	15.8
	28	59	1	18.6
Aug.	4	117	0	17.2
	11	118	0	17.6
	18	12	0	16.7
	25	0	0	17.0
Sept.	1	0	0	-
	8	0	0	16.6
	15	0	0	17.0
	22	0	0	-
Total		455	7	-

Appendix 6g. Weekly adult count at the Grand Falls collection facility, 1980. Mean weekly water temperature (°C) included.

Week Ending		(<62 cm)	(≥62 cm)	Mean Water Temperature
July	12	32	1	14.6
	19	265	1	16.1
	26	259	4	16.6
Aug.	2	99	0	12.4
	9	1,397	3	14.7
	16	594	0	14.6
	23	143	0	12.6
	30	173	1	13.3
Sept.	6	75	3	14.7
	13	23	0	-
	20	0	0	-
Total		3,060	13	-

Appendix 6h. Weekly adult count at the Grand Falls collection facility, 1981. Mean weekly water temperature (°C) included.

Week Ending		(<62 cm)	(≥62 cm)	Mean Water Temperature
July	11	95	4	-
	18	193	11	15.5
	25	787	26	18.6
Aug.	1	1,097	51	17.4
	8	634	37	17.9
	15	504	46	17.1
	22	235	21	16.0
	29	129	19	16.4
Sept.	5	82	12	16.9
	12	24	0	18.0
	19	15	0	-
Total		3,795	227	-